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FEDERAL COMMENT

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REGION 3 I.A.R.U.

During the past year there has been a move towards closer co-operation between the I.A.R.U. Societies of Region 3. The possibility of a conference is being investigated.

In Europe very successful meetings take place between representatives of the various Region 1 I.A.R.U. countries including some from Eastern Europe such as U.S.S.R., Poland and Czechoslovakia. However, we must bear the following in mind. The distances involved in Europe are less than those travelled by delegates to a W.I.A. Federal Convention. Due to the high technical development of Europe there are a large number of active Societies which, because of their close proximity to each other, have many common interests.

In Region 3 the distance between the major Societies is great and in estimating the cost of a Region 3 Conference, it is apparent that fares play the major part. Also in Region 3 there are some emerging nations where there is no Amateur Radio and whose administrations know nothing of it. This indicates that some missionary work on behalf of Amateur Radio in this region would not go astray. This type of work has been pioneered in Africa by the A.R.R.L. Africa presents very similar problems to Region 3 as all the Region 1 activity seems to be in Europe. If we are to have a Conference which is the best way to unify Amateur Radio in Region 3, then we must expect the major financial burden to fall on the strong Societies of the Region of which the W.I.A. is one.

D. A. WARDLAW.

CONTENTS

DF-2

A SYNTHETIC BATTERY FOR YOUR CARPHONE

(or how to make Transistor Regulated Power Supplies)

PART ONE

RODNEY CHAMPNESS, VK3UG*

SOME time ago I had cause to design and build several transistorised regulated power supplies. On looking through various magazines and so forth I accumulated quite a bit of "dope" on transistorised supplies. This was all rather beaut, the only troubles being that none were designed to supply more than 1 amp. and I required supplies that would deliver up around 10 amps. and not be too expensive to produce. The supplies were designed to take the load of a 60 watt transistorised transceiver, and put out between 12 and 14 volts under load.

The following designs will carry loads up to about 12 amps. with little modification. These units are just the shot if you want to run any equipment, transistorised or valved, which works off voltages in the 6 to about 18 volt range. They will certainly save having that messy battery hanging around the shack, with its attendant worry of charging, etc., when you only want to run the mobile sometimes on the bench.

These supplies will also double as efficient tapered-charge battery chargers; now that's something that has been always lacking from dealers' shelves. You only have to set the end voltage on open circuit, connect it to the battery and then go away and forget it and your battery will be fully charged but not overcharged. Well I'll get on with the description, circuits and pitfalls (and believe me there are enough of them until you wake up to them).

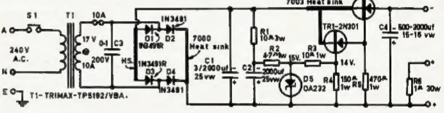
FIRST POWER SUPPLY

Circuit 1 shows the first power supply that I built. It is designed to provide up to 12 amps. maximum at 12 volts, and when off load it will produce about 14 volts, although I wouldn't recommend that you run it at 12 amps. for more than a few minutes, as take my word for it, it gets really hot. As a general rule, I wouldn't run it above about 7 or 8 amps. continuous as the junction in the transistor gets quite hot and the higher the temperature the more the transistor has to be derated from its maximum of 150 watts dissipation.

The power transformer used in this power supply is a 17 volt at 10 amp. unit available from Trimax. C3 is a transient suppressor capacitor, which is most desirable with silicon diodes. The diodes D1 to D4 consist of two 1N3491 and two 1N3491R. D1 and D3 are mounted on the one heat sink such as the Ferris type 7000, and are type 1N3491R; the diodes D2 and D4 are 1N3491 and are mounted on a similar heat sink. The transistor TR2 is mounted on a Ferris type 7003 heat sink. All these components are mounted directly onto three heat sinks for better heat transfer, so they must be suitably insulated from earth.

The 2N301 (TR1) is also mounted on a small heat sink of a few square inches; it does not have to be big as the 2N301 does not dissipate much heat. The diodes are fitted into stud adaptors, as in their normal state they have only a knurled edge suitable for fitting into automobile alternator blocks.

Across the diodes it is advisable to fit equalising resistors and capacitors, as shown in Circuit 2, the values shown would be suitable for Circuit 1. You can get away without equalisers as the p.i.v. across the diodes will not be higher than 48 volts but this is going close to the wind with diodes rated at only 50 p.i.v. The reason for equalisers is that one diode in a series train will commence conduction a fraction of a cycle sooner than the others, so placing the full peak voltage across the succeeding diodes and possibly causing the p.i.v. to be exceeded of the following diodes, causing a break down. I had it happen to me, so be warned.



CIRCUIT No. 1.

If you wish to do it by the brute force method, use the type 1N3492 which has a p.i.v. of 100 volts. In the later supplies I use the higher voltage diodes, and also the equalisers, just to be on the safe side.

Capacitor C1 consists of three 2,000 uF. 25 v.w. electrolytic capacitors. Allow here about 500 uF. per amp. of output current. The network R1 C2 is a voltage dropping filtering network. The filtering here is passed on through R2 to D5, the reference zener diode, which is a type OAZ232 and is rated at 7 watts 15 volts. This is mounted on the same heat sink as the 1N3491 diodes, this heat sink being the positive line. As 15 volts is a little high for 12 volt equipment, a fixed divider R3-R4 is used to establish an output voltage of about 14 volts. R4 could be replaced with a potentiometer, so giving variable output voltage. The disadvantage with this idea is that as the potentiometer is set for lower voltages, the regulation becomes decidedly inferior due to the variation in current drawn by the 2N301 base. Another point to consider is that the 2N441 will be required to dissipate more heat as the output voltage is decreased.

The resistor R5 is used to stabilise the output voltage. The leakage in the 2N301 causes the reference voltage to rise to the rectifier output voltage, and the resistor counteracts this effect. (Probably collector-emitter leakage, someone who knows more on transistors may be able to correct me if I'm wrong.) Capacitor C4 is used to give final filtering, particularly at the higher frequencies, as I found the voltage regulation much better in the supplies when this capacitor is fitted.

Well that is the gist of the first power supply, it is simple and easy to get going. There are no particular ways of construction necessary, with the exception that plenty of air needs to flow around the heat sinks. The fins must be in the vertical plane for efficient cooling. Incidentally, the resistor R6 was fitted to the output so that batteries could be charged from the supply. The supply output through the 1 ohm resistor can be shorted without harm for a short time, but most definitely not straight across the supply.

This is quite an effective supply and will fill many needs, but falls down in the following aspects: its voltage regulation, although not bad, could be improved; there is some ripple in the output; it is only suitable for about 12 volt use, and last, but certainly not least; it has no overload protection (which in some circumstances is not important, but you short the output and see if you have a workable 2N441 transistor in the unit after you remove the short). With all these short comings in mind I decided that a more sophisticated power supply was needed so the unit shown in Circuit 2 was evolved.

SECOND POWER SUPPLY

The advantages of the second unit are that it has only a variation of between ¼ to ½ volt between full load and no load, with loads ranging up to about 9 to 10 amps. The ripple on the output is indiscernable on the 3 volt range of an a.c. meter, so I reckon that is good enough for any equipment that I'm ever likely to use. One of the main features this unit has is the variety of

---

* 14 Buckley St., Sale, Vic.

overload protection circuits incorporated. It has both short term overload protection provided by TR1, and long term overload protection afforded by the Zettler relay, as well of course we have the standard cartridge fuse.

One other feature is the ease with which the output voltage can be set. This particular unit was designed with only one voltage output in view, namely 12 to 14 volts, but with slight alteration in the value of some components it will produce up to about 25 volts, although this voltage would only be available at rather low amperage.

The circuitry is very similar to the previous unit up to the output of the rectifier filter unit, with the exception that diode equalisation is used. Two transformers are used in series, giving an r.m.s. output a.c. voltage of 23.3 volts at a 4 amp. load, but on open circuit this r.m.s. voltage rises to 25 volts and the peak voltage that C6 charges to is in the vicinity of 35 volts. As the particular transformer I have used has only a rating of 4 amps., more current than this can only be drawn for short periods.

The function of TR3, 4, 5, 6 and C8 are the same as TR1, 2 and C4 in the first circuit. R13, 14 and 15 are equalising resistors for the 2N441 transistors to help maintain exactly the same or as near as the same current flowing through all transistors. If they are not fitted, one may take most of the current and as it gets hotter it will take increasingly more and eventually run itself to destruction. R5, 6 and C7 perform the same job as R1, 2 and C2 in the first circuit of filtering, and voltage dropping.

Now from here on the principle of operation differs considerably. The voltage for the base of TR3 is obtained through R5, 6 and this voltage is adjusted and controlled by the conduction of TR2. The emitter of TR2 is held at a certain voltage negative in respect to the positive terminal of the rectifier output. The current necessary to keep D5 conducting is obtained through R10. TR2 has its base taken to a voltage divider across the output (R12). The setting of this potentiometer governs the relative voltage between base and emitter of TR2 and so the relative conduction.

Depending on the relative conduction of TR2, depends the voltage present at the base of TR3, and so the output voltage of the supply. Now say a heavy load is placed onto the output, so bringing the voltage down a volt or two. As the voltage has been reduced, so drastically the base emitter voltage of TR2 will be reduced, therefore it will possibly even be cut off, so meaning that TR3 will get a much increased voltage to its base, which will be reflected in a greater output voltage. The output settles down to a value which is very nearly the same as the original voltage (it happens much quicker than can be described) and also the converse is true should the load decrease and the voltage tend to increase.

To obtain best regulation the negative lead of the potentiometer R12 should go right to the respective output terminal. By doing this any voltage drop in the wires to the output socket are automatically compensated for in the supply regulation circuit. As a matter of interest the mathematical increase in the effective capacity is the value of C7 × gain of TR3 × gain of TR4, which works out roughly to 2000 × 30 × 20 = 1.2 Farads. Not bad huh?

Where this supply's regulation beats the simpler supply is that the regulation error voltage is obtained from the output, whereas with the simpler supply regulation is applied before the filter transistors.

R12 is the voltage output preset or it can be a variable on the front panel. If you require to run the output of this supply over a wide voltage range two alterations should be made. R10 should be increased in value to 3.3K and instead of going to the emitter of the 2N441 transistors, it should go to the collectors. R12 should have a 560 ohm resistor placed in series with its positive lead.

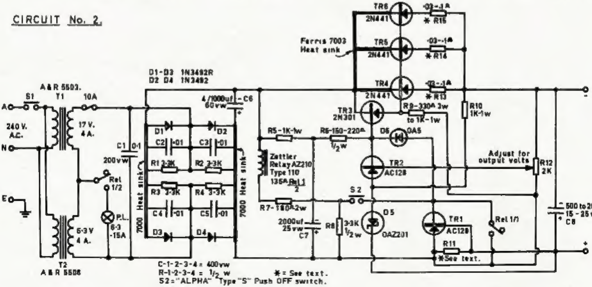
I suppose you have been wondering why I used three 2N441 transistors in the output of this supply and I only used one in the simple supply, and the output currents are approximately the same. Well a little arithmetic is desired here. When a drain of 10 amps. at 13 volts output is in use, the input voltage on the collectors of the 2N441s is about 21 volts so the total wattage dissipated by the transistors is 10a. × (21v. — 13v. = 8v.) = 80 watts. Now each of these diodes can stand 150 watts and 15 amps. each. What a waste of transistors you'll say. They are, unfortunately, very necessary if long life of these transistors is the aim.

Consider now the supply on open circuit, the voltage is 35 volts across C6 and you now accidentally short the supply. The current even with the overload circuits will allow for a short-time 14 amps. to pass, even though the overload is set to commence operating at 9 to 10 amps. Now 14 × 35 is 490 watts and the combined ratings of the transistors is only 450 watts, so perhaps I'm being a little on the Scotch side. The overload current quickly drops to about 12.5 amps. within a very short time, so before the junctions have time to overheat the dissipation is below their maximum wattage. I blew up two transistors before I woke up to the fact that this severe overload was altogether too severe.

OVERLOAD CIRCUITS

Now to the operation of the overload circuits. TR1 is the overload transistor and it is normally in the cut-off condition as the current in the resistor R11, and so the developed voltage, is so low that up until about half of the normal maximum output current is drawn from the supply it does not conduct. As the voltage across R11 rises, TR1 commences to conduct and draws current through the relay and R7 and so the voltage at the collector of TR1 gradually comes nearer to the

CIRCUIT No. 2.



positive rail of the supply. As this voltage becomes lower it eventually reaches a point where the collector of it is the same as the collector voltage of TR2. When the voltage on the collector of TR1 is more positive than the collector of TR2, D6 will commence to conduct so lowering the reference voltage at the base of TR3, and so dropping the output voltage.

The more current that is drawn from the supply, the lower the voltage will become and if the overload is only gradual the voltage will only be a fraction of a volt with current drawn of about 12.5 amps. The size of R11 is adjusted so that the diode D6 will only just start to conduct when the maximum normal current of about 9-10 amps. is being drawn. R11 consists of a length of 22 to 24 B. & S. enamelled wire, the length determined by experiment, but should be in the vicinity of 6 to 7 inches. The emitter resistors of TR4, 5 and 6 are also made of enamelled wire, being about 25 inches of 26 B. & S.

Now the overload if sustained will make things all very hot, and possibly cause the transistors and the power transformers to go up in smoke after quarter of an hour or so, as the heat sinks get warm enough under normal full load conditions. To combat this problem I fitted a small relay with two c/o. sets of contacts. As the relay is in the supply line to the overload transistor, it will be energised and will pull in after a fraction of a second, so placing the base of TR3 virtually at positive potential, meaning that there will only be a fraction of a volt output. The current I have measured across the output has been in the range ¼ to ½ amp., which is well within the power supply capabilities. The other relay contact brings on a pilot globe which gives an indication that the overload has occurred.

If now S2 is pressed, it releases the relay and if the overload is removed the supply resumes normal operation. The resistor R8 is to keep the peak voltage to the collector of TR1 to below 32 volts when the supply is on open circuit, as its maximum collector emitter voltage is 32 volts. The OA5 is recommended for D6 due to its low forward resistance and high current carrying capability.

That about completes the description of the circuit, there are no particular pitfalls in building it. The three 2N441 transistors can all be mounted on a single 7003 heat sink. The general building tips apply equally to this one as to the simpler supply. I built all the control circuits onto a piece of matrix board and clamped the AC128 transistors down onto a heat sink, separate to the main supply heat sinks.

ALTERNATIVE CIRCUITS

I have been having some further thoughts on these power supplies and should you require 8 amps. continuously at 13 volts or thereabouts, I would suggest that instead of having two transformers in series, two 17 volt 4 amp. battery charger transformers should be purchased and used. The transformers will also take it much more kindly, or a transformer the same

(Continued on Page 10)

Versatile Loads for Power Supply Tests

S. T. CLARK,* VK3ASC

Recent visitors to my shack, who have seen the dummy load I use for power supply tests, have indicated that they will use the idea in their own shacks.

The load consists simply of 12 batten holders and five switches, and a three-pin plug fitted to a sheet of Masonite with a 1½ in. x ¾ in. wooden surround.

The batten-holders are wired in series in four groups of three. In series with each group is a switch of the snap action type (Ring-Grip or other surface mounting type with a large air gap). In series with the system is placed the three-pin plug.

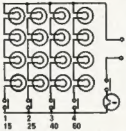


FIG. 1.

15w. equals 1.
25w. equals 2.
40w. equals 3.
60w. equals 4.
60 plus 15 equals 5.
60 plus 25 equals 6.
60 plus 40 equals 7.
60 plus 40 plus 15 equals 8.
60 plus 40 plus 25 equals 9.
60 plus 40 plus 25 plus 15 equals 10.

Main switch permits opening/closing load system. Three-pin plug makes series metering (current) measurement easy or permits use as series dropper for tests on small motors, etc.

By using up to 12 lamps, with shorting adapter plugs as necessary, it is possible to test power supplies of almost any rating up to 800v. In my case I usually, but not always, use lamps of 15, 25, 40, 60 watt rating in each string of 1 to 3 lamps and by switching in the desired sequence can simply and cheaply obtain ten current increments from open circuit to maximum load.

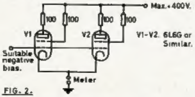


FIG. 2.

Resistors could be substituted in the same manner if desired, but since these are more expensive than the lamps and not so convenient, I use the lamps.

The second load I have used which may also be used as a series regulator consisted of two 6L6 type valves taking their heater supply from a small transformer which also supplied sufficient voltage to bias the tubes off.

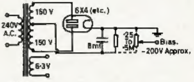


FIG. 3.

So long as resistors of about 100 ohms are inserted in series with plate and screeen connections practically any number of tubes may be operated in parallel. They can be of almost any type—6L6, 807, 1625, 6CM5, etc., can be used. It is only necessary to watch that plate current and plate dissipation ratings are not exceeded. The 6L6, 807 and 1625 will handle 25 watts per tube, i.e. 100 mA. with 250 drop across the tube.

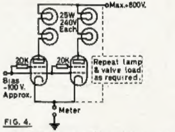


FIG. 4.

With modern transformers bias of 100v. may be easily obtained from a winding of about 40v. by using a voltage doubler. The full wave voltage doubler circuit is as shown.

By feeding the plates through load resistors, lamps work well and strapping the screen to the grid through a resistor of 10-20k ohms for hi-mu triode type operation these tubes will handle up to 800v. without any trouble and dissipate up to 75w. per leg, consisting of tube and two 25w. 240v. lamps in series. The bias adjustment pot or pots permits continuously variable control so that load current may be set at any value which may be convenient.

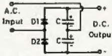


FIG. 5. C = 2 To 8mf.

Use silicon selenium rectifiers with p.i.v. (p.r.v.) of 4 x r.m.s. input voltage for safety. Capacitors may be quite small, 2-8 mf., because current drain is limited to a few mA.

---

[*] 26 Bellevue Ave., Rosanna, N.22, Vic.

SILENT KEY

It is with deep regret that we record the passing of:

VK2IN—Arthur Meadows.
VK2OP—A. Roy.
VK3LP—Geo. Wiburd.
VK6TS—Alf. Schofield.

CRYSTAL DIVISION

Announcement—

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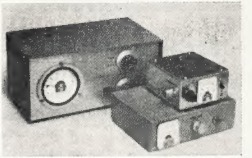
THE VARIMATCHER*

An Easily-Reproducible S.W.R. Bridge featuring Adjustable Impedance

DOUG DEMAW, W1CER



● It's said, "There's nothing new under the sun," and perhaps this is true where s.w.r. bridges are concerned. After all, the field has been well covered in recent years. Nevertheless, the bridge described in this article represents a new approach, not only in securing better sensitivity from the Ham shack s.w.r. bridge, but also in minimising the mechanical problems in building such a unit.

THE "Varimatcher" is an outgrowth of the author's attempt to build an s.w.r. bridge that could be balanced easily and could be duplicated with a minimum of effort. Since it was desirable to have better sensitivity than was common in other bridge types, emphasis was placed on that facet of the project as well.

Four models of the Varimatcher were built and tested. All units performed satisfactorily from 160 through 2 metres and although each model was purposely built with different physical dimensions, line lengths and placement in the cabinets being dissimilar, all four balanced easily and with no fuss.

The Varimatcher requires no juggling of resistor values, no pruning or bending of wires to attain initial balance, and no matching of component values other than the diodes.

The sensitivity is such that full scale deflection with a 1 mA. meter will occur on 160 metres when 27 watts of r.f. power is fed through the bridge. A power level of 7 watts will produce full scale deflection on 3.5 Mc. Progressively less power is needed as the operating frequency is increased.

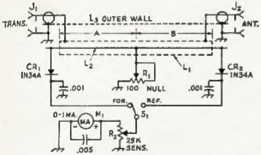


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Fig. 1.—Schematic diagram of the W1CER Varimatcher. Capacitors are 1,000 volt disc ceramic and values are in pF.

CR1, CR2—Matched germanium diodes, 1N34A or equal.
J1, J2—SO-239 co-ax. fitting.
L1, L2, L3—See Fig. 4.
M1—1 mA. meter.
R1—100 ohm, linear-taper carbon control. See text for fixed resistor values.
R2—25,000 ohm linear-taper control.
S1—S.p.d.t. toggle or slide switch.

★

An additional feature was desired, that being the ability to use the Varimatcher with either 50 or 75 ohm lines without the need for changing the terminating resistors on the pick-up line. A 100 ohm potentiometer (low resistance type) used as a termination, and accessible from outside the cabinet, makes it possible to null the bridge for either impedance in a matter of seconds. More on this later.

HOW IT WORKS

R.f. from the transmitter is applied to the bridge at J1, Fig. 1. The current flows along L1 and out through J2 to the load. The pick-up line, L2, is centred in L1. Because L2 is inside L1, and because the line current does not flow on the inner wall of L1, coupling between the two takes place only at the ends. This arrangement offers two benefits: The reflected and forward power portions of the pick-up line, L2, are divorced from one another physically, resulting in better isolation between the two halves of the pick-up element. This contributes to better balance in the bridge. Also, with this construction it has been found that it is unnecessary to tinker with the value of terminating resistance, regardless of the element length or shape. The termination is approximately 51 ohms for 50 ohm lines and 33 ohms for 75 ohm lines.

The bridge in Fig. 2 has an outer conductor, L3, for the co-axial element (outer channel and L1) which is necessary to prevent stray coupling between the forward and reflected power ends of L2. The walls of the bridge cabinet in Fig. 3 tend to serve the same purpose.

Some of the forward power is sampled by section A of L2 and rectified by CR1. Similarly, the reflected power is sampled by section B of L2 and is rectified by CR2. The meter switch, S1, routes the direct current from CR1 and CR2 to the sensitivity control, R2, and then to the 1 mA. meter. The meter is adjusted for full scale deflection with S1 in the **forward** position by varying the resistance of R2, and if the line is matched to the load, there will be no reading when the meter is switched to read reflected power. The higher the standing wave ratio, the greater will be the meter deflection in the reflected position.

BUILDING THE BRIDGE

Ordinary hand tools can be used for building the Varimatcher. The bridge channel, L3, can be formed in a bench vise. The ¼ inch diameter copper tube, L1, can be cut to length with a hacksaw or tubing cutter. The hole in the centre of L1 is made with the narrow side of a flat file. The important consideration when forming the parts of the bridge is to maintain symmetry. The walls of L3 should be ⅞ inch apart across the entire length of the channel. The centre hole in L1 should be equidistant from the ends of the line. Pick-up line L2 is made from the inner conductor and polyethylene insulation of a piece of RG-59/U co-ax. cable. The ends of L2 should protrude equally from L1 (Fig. 4). The connection to R1 is made by a short length of bus wire (the shorter the better) from the centre of L2 to the centre lug on R1.

The tap on L2 should be made before the pick-up line is inserted into L1. This can easily be done by cutting away approximately ¼ inch of the poly insulation at the dead centre of L2 and soldering a 2 inch length of No. 20 bus wire to the element. The bus wire should be folded back against the pick-up line and pulled through L1 until it is visible at the centre hole of the copper tubing. It is a simple matter to pull it out through the hole for connection to R1 after which a few drops of epoxy cement should be placed in the hole. This will insulate the centre tap wire and will anchor L2 inside L1, assuring long-term symmetry. (Do not insert L2 into L1 until after L1 is soldered to J1 and J2).

The co-ax. fittings, J1 and J2, are mounted on one wall of L3, Fig. 2, and R1 is at the centre of the same wall. L1 is centered in L3 and soldered to J1 and J2. Fixed resistors can be used in place of control R1 if only one transmission line impedance is to be used. The resistors should be ½ watt composition units, preferably with 5 per

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* Reprinted from "QST," May 1966.

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Pulse Diode, Type K2C .... **78c** plus S.T. 12½%
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Please add packing and post, 10c set.

NOTE: A Circuit is available for making a 1,000 watt Light Dimmer using K5B20, K2C, Pulse Transformer and a few Resistors and Condensers. Write or call for a copy.

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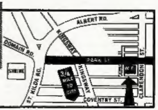

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cent. tolerance. Normally, the lead length between the fixed resistors and the centre of L2 should be kept as short as possible. The ½ watt resistors showed no evidence of capacitive or inductive reactance that would cause bad effects in the 1.8 to 30 Mc. range, but at 50 and 144 Mc., they showed a small amount of capacitive reactance, and some experimenting with the lead length between L2 and R1 was required to get a good null. The inductance of the lead between R1 and L2 can be used to cancel the capacitive reactance of the resistor at v.h.f. This has no effect on the performance of the bridge in the 1.8 to 30 Mc. range.

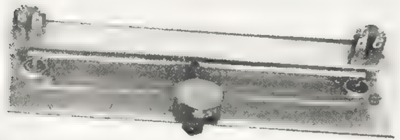


Fig. 2.—Bridge element of the Varimatcher. Style of construction permits mounting the bridge in transmitter cabinets, transmatch housings, or individual cabinets. The diode pigtails are routed through the holes in the outer channel and are soldered to the terminal lugs. The 0.001 pF. capacitors are also soldered to the terminal strips at the ends of the channel.

Because a 51 ohm ½ watt resistor does not act like 51 ohms at 144 Mc., but more like 56 ohms, the accuracy drops off in the v.h.f. range. An actual s.w.r. of the order of 1.3 to 1 might appear to be a ratio of 1 : 1. Nevertheless, the bridge is accurate enough to be useful for most applications, and is not necessarily any less accurate than other reflected power bridges used at v.h.f.

The bridge shown in Fig. 2 uses an Allen-Bradley 100 ohm linear-taper control for R1. Of the many brands tried, the Allen-Bradley (Ohmite) potentiometer was the least reactive. In practice, it compares favorably to the ½ watt fixed resistors used. The bridge of Fig. 1 and Fig. 2 was nulled at 144 Mc. and held calibration over the entire range from 1.8 to 148 Mc.

When soldering CR1 and CR2 into the circuit, be sure to grasp the pigtails of the diodes with a pair of long-nose pliers so as to conduct heat away from the bodies of the diodes. This will prevent damage to the units. The wiring from the cathode ends of CR1 and CR2 is not critical and can be routed along the sides of the cabinet.

A more compact version of the Varimatcher is shown in Fig. 3. The bridge element is bent into a U shape to cut down on the space required in the box. No outer channel (L3) is used, as the sides and the bottom of the box tend to serve that purpose. The length of L1 is six inches in this model, but the circuit is the same as that shown in Fig. 1. A 2 x 4 x 4 inch utility box is used to house the bridge and the layout is symmetrical. Details are shown in the photo.

Individual taste will dictate the size and shape of the cabinet for the bridge of Fig. 2, since the length of the bridge element is not critical. The important thing to remember is that the shorter the bridge unit is, the less sensitive it will be, and the less will be the isolation between the reflected and forward power sections of the pick-up line L2. A 4 inch element was used in the model pictured in Fig. 5. Balancing the bridge at v.h.f. became a bit more troublesome in this model, indicating that this might be a practical limit in miniaturisation of the Varimatcher.

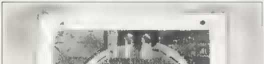


Fig. 3.—A miniature version of the Varimatcher. L1 and L2 have been bent into a U shape to conserve space. The circuit is the same as Fig. 1 but the length of L1 has been reduced to six inches. The bridge cabinet measures 4 x 4 x 2 inches.

ADJUSTING THE VARIMATCHER

If the bridge is to be used no higher than 30 Mc., it should be checked out on the 10 metre band. A Heath Cantenna or equivalent 50 ohm dummy load should be connected to J2. The more accurate the termination at J2, the more accurate the bridge will be. A home-made dummy load, usable at power levels of ½ watt or less, is illustrated in Fig. 6. It is quite accurate from 1.8 to 55 Mc., but at 144 Mc. will show capacitive reactance as in the case of terminating resistor R1, Fig. 1. As this will cause the bridge to be inaccurate at 144 Mc., an effort should be made to borrow a good 50 ohm termination for 2 metre calibration. If the Varimatcher is to be used on 2 metres, the initial checking should be done at that frequency.

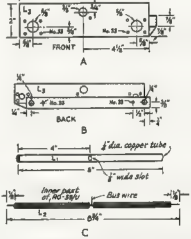


Fig. 4.—Layout dimensions for the bridge. At A, the outer channel (L3). At B, the back side of L3. Shown at C, the copper tubing dimensions (L1) and the inner line L2. L2 fits into L1 after the bus wire is soldered to the centre of L2.

With a few watts of power applied at J1, adjust R2 for full scale deflection of the meter while S1 is in the forward position. Then set S1 to the reflected position and adjust R1 for a null in the meter reading. This should be zero deflection when the circuit is working properly. If the bridge is to be set up for use with 75 ohm loads, the procedure is the same but a 75 ohm dummy load must be used.

If fixed resistors are used in place of the control of R1, no tinkering should be required to secure a perfect null in the 1.8 to 30 Mc. range. For 2 metre use, however, the lead length

between R1 and the centre of L2 must be adjusted until a suitable null is obtained.

After nulling the bridge, check again and make sure that full scale meter deflection occurs at the forward position of S1. Next, reverse the cables at J1 and J2, set S1 to the reflected position, and see if a full scale meter reading results. If CR1 and CR2 are reasonably well matched, the meter readings will match up. If you do not wish to purchase a set of matched diodes, and have a supply of 1N34s on hand, you can select a pair that will work well in the circuit by measuring the front and back resistance of a few of them and picking a pair that are about the same value.

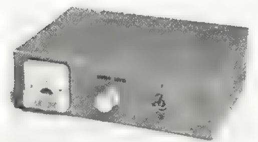


Fig. 5.—A mobile model of the Varimatcher, made to fit under a Heath TWOer or SIXer. The circuit is the same as Fig. 1 but the bridge has been shortened to a four inch length.

USING THE BRIDGE

The Varimatcher will handle the full output of a kilowatt transmitter. The models described in this article were tested with the author's 2-kw. p.e.p. input transmitter on all bands from 3.5 to 29 Mc. Additional tests were made on 6 and 2 metres at lower power levels. With R2 wired into the circuit as shown in Fig. 1, the resistance in series with CR1 and CR2 must be **decreased** to maintain a full scale meter reading as the transmitter power is increased. Table 1 gives the r.f. power levels required for full scale meter deflection (1 mA. meter) at maximum sensitivity for a 6 inch element. The Varimatcher can be used with very low power v.h.f. rigs for tuning and matching adjustments. A feature which should appeal to the solid-state experimenter. Even greater sensitivity could be realised by substituting a 100 μA. meter for the 1 mA. unit. This should not be necessary, however, for normal applications.

Power for Full Scale Meter deflection, L1 = 6 inches

Band	Power
160	22 watts
75	7 „
40	2 „
20	0.7 „
15	0.45 „
10	0.2 „
6	0.1 „

Table 1.

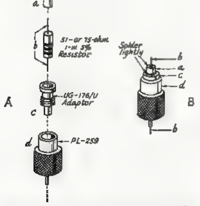


Fig. 6.—Details for building a 50 or 75 ohm dummy load for balancing the bridge. This low-reactance load is useful for adjusting R1 at v.h.f. Do not permit the resistor to become overheated when soldering the unit together. Keep all leads as short as possible. See text for details on the use of this load. (Resistor is carbon.)

The Varimatcher has many uses. It can be used for mobile, fixed, or portable operation.

If you have put off building an s.w.r. bridge, now might be the time to get the job done. The cost of the Varimatcher is nominal and the unit can be built in a few hours. Don't forget—this is the season for building, repairing and adjusting antennae. The Varimatcher will help you to get that feed line matched to the antenna. ●

☆

A SYNTHETIC BATTERY FOR YOUR CARPHONE

(Continued from Page 5)

as I used in the first supply could be purchased.

Another advantage of the lower voltage is that lower voltage filter capacitors can be used, i.e. 2000 uF. 25 v.w. instead of 1000 uF. 60 v.w. for the rectifier filter section. Resistor R9 could quite possibly be reduced to 330 ohms, as I think that the 1000 ohm resistor is a little on the high side. The resistor should have a rating of 2 to 3 watts. With three transistors in parallel I think the transistor leakage is possibly a little high to be completely handled by this higher value resistor. When the overload relay pulls in and the output is "un-short-circuited" the voltage of the output rises to about 6 volts, but with very little current though. The base of the 2N301 is clamped to approximately ½ volt so I think this is the explanation, as the 2N301 would in general keep the output to this figure less this leakage was high.

You may well say a 10 amp power supply is all very well, but my equipment draws more than 10 amps. Well if you only require about 13 volts on load and you use a 17 volt transformer that will take the full load without the voltage falling more than about a volt, the second power supply could be set so that the overload circuit did not commence operating before the current had reached 13 amps., this might be suitable. The wire necessary for R11 I would recommend being now 20 B. & S. The overload pilot could be arranged to be supplied through a series resistor across the 17 volt transformer.

Perhaps you have some 6 volt equipment that you want to build this up for, well I would suggest getting hold of a hefty 12 volt transformer and build a supply similar to the above types, and adjust the overload to come in at about 16 amps. The reference zener diode might be changed to a OAZ200, as it has a slightly lower zener voltage. The size of R5 would have to be lowered, as would R10, the resistance perhaps of the Zettler relay and the attendant series resistor R7. R8 would not be required in this supply or any supply using a transformer rectifier system where the peak off load voltage does not exceed about 30 volts; AC126s don't like more than 32 volts across them. Zettler relays are available, I imagine, from a number of firms although I have only seen them advertised by one, by a firm located in Spencer Street, Melbourne.

Well that about wraps it up chaps. Hope this article has given you a few ideas on this type of equipment and its uses. I will be building a higher amperage 13 to 14 volts unit which I am hoping will put out up to 18 amps. with no great strain, possibly incorporating an even more sophisticated overload circuit, with delayed overload lock-out. (Part Two of this article will contain this proposed new supply.) This newer supply will have a larger heat sink and I would certainly recommend that you use a larger heat sink, possibly two 7003 heat sinks, if you intend taking about 10 amps. continuously from one of these described power supplies.

As the existing supplies I have made only supply their maximum current for about 30% of the time, I don't need to worry unduly about the heat sinks as they cool off in between transmissions.

The supplies I have built, you will notice, have neither side of the output earthed so your equipment can have any pole earthed with safety.

AMATEUR FREQUENCIES:

ONLY THE STRONG GO ON—
SO SHOULD A LOT MORE
AMATEURS!

TRANSISTORISED SIDEBAND

COL HARVEY, VK1AU (Ex VK3UO, VK2AQU, VS1AU)*

WITH commercial equipment now readily available for use on the Amateur bands, home construction and experimenting is becoming the prerogative of the inquisitive and the poor. This article shows how Amateur know-how and simple facilities can be used to up-date an existing transmitter or provide the basis for home construction of a modernised sideband exciter.

When the phasing exciter, built in 1959, was replaced four years later by a mechanical filter exciter I firmly believed that the combination of a mechanical filter, a gated beam 7360 balanced modulator and carrier generator, and a 12AX7 speech amplifier was so satisfactory that it would probably continue in service indefinitely. However, Amateur Radio being the hobby it is, discussion soon produced an urge to try some form of transistorised project. In the same way in which the original phasing project caused doubts that the project was probably too complicated for an Amateur without good test equipment, so with the transistorised project. However, in both cases, making the decision to start was more difficult than achieving fulfilment. Although access to an operating sideband transmitter made the project very much easier, the notes which follow should make it possible for anyone with normal Amateur inquisitiveness to start from scratch and succeed.

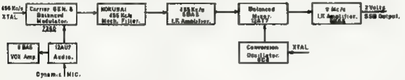
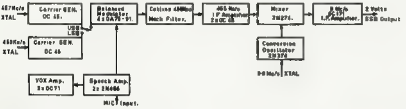


FIG. 1a. VS1AU - VK1AU. 1962-1966.



F.G. 1b. VK1AU 1966 - ?

As in most projects which do not exactly follow a published design, the basic problem is to decide the number of stages and hence the layout which will be needed. The knowledgable calculate this from first principles, but the suck-it-and-see process is almost as good and for most of us probably as quick. Fig. 1 (a) and (b) show the comparative block diagrams for the same exciter, one using valves, the other transistors. This should make it easy for you to insert your own approximations. The linear is still the old converted c.w. rig described in "A.R." about six years ago, which uses an 803.

THE SPEECH AMPLIFIERS

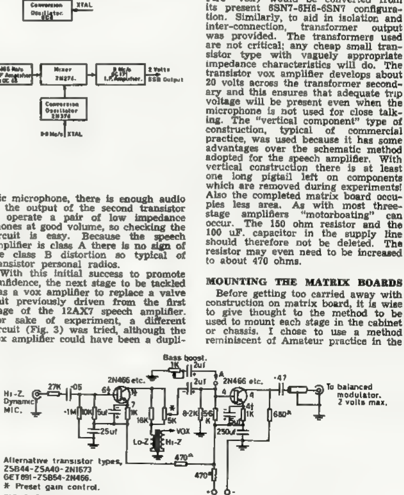
Obviously the easiest place to start a transistorised conversion is in the audio stages. The circuit at Fig. 2 produces very similar results to those obtained with a 12AX7. The response is better and the transistorised version seems to be less sensitive to hum and r.f. pick-up. Using a low output dynamic microphone, there is enough audio at the output of the second transistor to operate a pair of low impedance phones at good volume, so checking the circuit is easy. Because the speech amplifier is class A there is no sign of the class B distortion so typical of transistor personal radios.

With this initial success to promote confidence, the next stage to be tackled was a vox amplifier to replace a valve unit previously driven from the first stage of the 12AX7 speech amplifier. For sake of experiment, a different circuit (Fig. 3) was tried, although the vox amplifier could have been a duplicate of the speech amplifier, and vice versa. Here I met my first stumbling block. In a valve amplifier, capacity coupling suffices to link the vox amplifier and the speech amplifier. This proved impractical in the transistorised version because it caused a severe reduction in output from the speech amplifier. Eventually I decided the easiest way was to use the audio signal passing from the first collector to ground via the volume control. Inserting the low impedance winding of a transistor transformer in this lead provided easy pick-off and did not affect the output of the speech amplifier.

Additional gain was intentionally provided to anticipate the time when the original outboard relay unit (the "Sure-Fire" vox) would be converted from its present 6SN7-6H6-6SN7 configuration. Similarly, to aid in isolation and inter-connection, transformer output was provided. The transformers used are not critical; any cheap small transistor type with vaguely appropriate impedance characteristics will do. The transistor vox amplifier develops about 20 volts across the transformer secondary and this ensures that adequate trip voltage will be present even when the microphone is not used for close talking. The "vertical component" type of construction, typical of commercial practice, was used because it has some advantages over the schematic method adopted for the speech amplifier. With vertical construction there is at least one long pigtail left on components which are removed during experiments! Also the completed matrix board occupies less area. As with most three-stage amplifiers "motorboating" can occur. The 150 ohm resistor and the 100 uF. capacitor in the supply line should therefore not be deleted. The resistor may even need to be increased to about 470 ohms.

MOUNTING THE MATRIX BOARDS

Before getting too carried away with construction on matrix board, it is wise to give thought to the method to be used to mount each stage in the cabinet or chassis. I chose to use a method reminiscent of Amateur practice in the



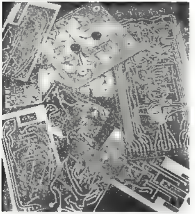
Alternative transistor types,
ZSB44-ZSA40-2N1673
GET891-ZSB54-2N466.
* Preset gain control.

FIG. 2. SPEECH AMPLIFIER.

The response of this Collins amplifier peaks at 3 Kc. If this is not to your liking, low frequency "boost" can be introduced by connecting a tone correction capacitor between earth and point A. Very little audio is needed for correct operation of the balanced modulator.

---

* 16 Leane St. Hughes, A.C.T.



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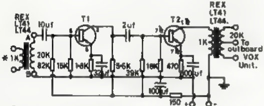
1930s when wood was a common constructional material. An appropriate length of wooden strip of the desired length and height can be quickly slotted with the hack or panel saw and subsequently screwed or Araldited to the chassis so that the matrix board can slide into the saw slots. The board will be retained by friction if the slots are an appropriate width; or the boards can be secured by a screw. If the wooden rails are planed smooth and painted or sprayed before mounting, a first class appearance is obtained.

PROBLEM AREAS

With the two easiest sub-chassis tested and put aside, the project enters an area where trouble can be encountered, which will be difficult to resolve unless the means exists to listen to, or alternatively measure in some way the existence or non-existence of r.f. signals needed for normal operation. With access to such facilities, valuable experience will be gained particularly in experiments with the balanced modulator and carrier oscillator sections. All the problems encountered at VK-1AU were amenable to correction by normal Amateur methods, supplemented with a little patience and some good on-the-air advice. Amateurs with only a reasonable multimeter, a general coverage receiver and some form of r.f. indicator and a frequency meter need have no qualms about attempting a similar project.



* To speech amp.- See FIG.2.

FIG. 3a. T1-2. OC71-OC70-2N186- 2N280- ASY14.

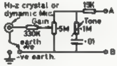


FIG. 3b.

This circuit was developed by Philips for use as a gramophone amplifier. With a pair of outboard OC72s, it can develop 200 mW from only ¼ volt input. If used as a speech amplifier, the input arrangement at (b) will be needed for high impedance input.

The following will suggest possible courses of action in the event of unsatisfactory operation.

L.f. crystal fails to oscillate:

Adjust emitter tank coil Q.
Select more active crystal.
Adjust feedback capacitor and/or emitter by-pass.
Adjust bias.
Reduce loading.
Check resonant frequency of tank coil.
Increase feedback—if necessary with a tickler.

Balanced modulator fails to balance:

Ensure the modulator/filter interface is capacitatively balanced. (Appearances can be deceptive and some filters may require connection via an i.f. transformer.)
Ensure all diodes are serviceable.
Reduce drive from carrier oscillator.
Avoid r.f. feedback from later stages.
Ensure output from upper and lower sideband crystals is identical and optimum.

Incomplete carrier balance:

Reduce carrier oscillator drive to the optimum value for the diodes in use.
Match diodes for similar forward resistance.
Adjust resistive and capacitance balance carefully.
Avoid leakage around the filter.
Avoid regeneration in stages after the filter.
Ensure that the injection oscillator frequency is down the skirt of the filter.

Unstable balance:

Avoid wire wound balance potentiometers.
Use plated crystals.
Avoid r.f. feedback.
Use quality diodes to minimise temperature effects.

Balance changes when linear is operating:

Improve s.w.r.
Reduce stray r.f. in the back.
Avoid r.f. pick-up in tuned circuits of low level stages operating near signal frequency.
Improve shielding and by-passing.

Insufficient sideband suppression:

Set carrier frequencies about 20 db down each skirt of the filter.
Avoid regeneration in amplifier stages after the filter.
Reduce drive and injection levels to mixer stages.

Inefficient mixing:

Use normal d.c. voltage when testing.
Provide good Q and loose coupling.
Adjust signal and oscillator voltages for optimum output. Keep low.

SIGNAL LEVELS

As some of the procedures suggested above necessitate r.f. measurement, it is mandatory to have some means of indicating the presence of low level r.f. Although this can be done roughly by ear, or S meter if the signal can be fed to the receiver, it is more convenient to have some form of r.f. probe. Few Amateur shacks have access to accurate test equipment, consequently any statement of r.f. voltages is likely to be meaningless unless both experimenters have access to similar equipment of comparable accuracy. Nevertheless, as it is important in getting new equipment operative, to know what approximate signal levels are involved, the following procedure may prove helpful.

The object is to provide relative measurements and an indication upon which to tune, rather than a specific voltage measurement. It is based on the use of a frequency meter such as the BC221 as a source of low level r.f., an r.f. probe (see Fig. 4), and a cheap v.t.v.m. with an 0-1½ volt d.c. scale. If this combination will read the r.f. output of the frequency meter, then it will have sufficient sensitivity to provide useful comparisons in the low level r.f. stages of a sideband exciter. With no load, my BC221 produces full scale deflection of the v.t.v.m., i.e. 1½ volts d.c.

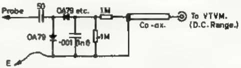


FIG. 4. R.F. PROBE.

A typical v.t.v.m. probe, easily built into a pill box. The probe tip is a three-inch bolt. My receiver b.f.o. and local oscillators develop about 3 volts d.c. with the circuit values given above.

Transferring the probe to the exciter then gives the following comparative readings:—

BC221 or 455 Kc. osc. at input to the balanced modulator:
  Quarter scale (due to load resistor).
Either side of the filter:
  Quarter scale (because the probe unbalances the modulator).
Mechanical filter output:
  Nil (because the filter attenuation is about 10 db).
455 Kc. i.f. transformer primary:
  Half scale (if audio tone applied or modulator unbalanced).
9 Mc. mixer output:
  Quarter scale.
7 Mc. mixer output:
  Half scale.
Audio output:
  Nil (because the probe coupling capacitor is too small for audio).
Mixer oscillator injection level:
  Quarter scale.

Because the probe v.t.v.m. combination has not been calibrated, there is no point in offering numerical values. It should be noted also that switching the frequency meter from 455 Kc. to the equivalent frequency on the h.f. range reduces the v.t.v.m. reading by about 30%. Whether this is due to reduced probe response or to reduced output of the frequency meter is not known. However, a v.t.v.m. reading will still be available even at 9 Mc., which will be sufficient to allow adjustment of the exciter.

FILTER PASSBAND

At Figs. 5 (a) and (b) the method used to check the passband of the available mechanical filter is shown, together with the result. Note the effect of a minor change in frequency on the output of the amplifier after the filter. Note also that with the transmitter i.f. amplifier loosely coupled to the i.f. of the station receiver, the resultant signal can be heard and the conversion from double sideband to

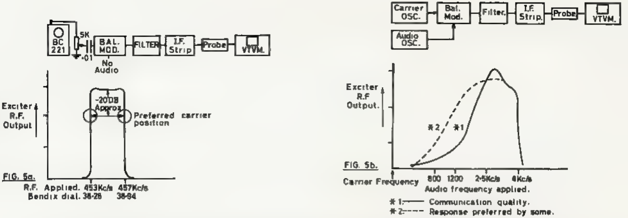


FIG. 5a.

FIG. 5b.

Because the response curve is so steep-sided, a small change in frequency causes a large change in output. If the carrier is placed too far down the slope the lower frequency audio components will be attenuated. The peak in the response at about 2½ Kc. is due to the characteristics of the balanced modulator with 0.01 uF. inserted at X. The final result will be a compromise between carrier frequency, desired response, and resultant suppression.

single sideband observed as the injection frequency is moved across the plateau to the skirt.

Whilst set up like this, the i.f. transformer in the i.f. strip should be set to give maximum response at the centre of the filter passband. This will improve the overall response curve and ensure optimum suppression. With a serviceable mechanical filter the whole of each skirt will be covered by a change of dial setting on the BC221 of only 17 graduations (e.g. between 38.11 and 38.28). The entire passband of my filter lies between dial readings of 38.11 and 39.07, and the shape factor closely follows those advertised.

CHOICE OF DIODES FOR THE MODULATOR

The reverse resistance is of little significance in diode modulators but reasonable care must be taken to eliminate diodes which are not similar in forward (low) resistance. This is because, under modulation, differing voltage will be developed across unmatched diodes and may be sufficient to unbalance the bridge. This causes reappearance of carrier and roughish audio. It is therefore well worth while to set up some accurate method of measuring forward resistance. Regardless of the type of diode chosen, this criterion is the one to apply when matching. It will not overcome capacity unbalance caused by temperature variation, which can be as much as 1 pF. per degree F.

THE CARRIER GENERATOR

With preliminary arrangements for checking decided, construction of the carrier generator oscillator can be commenced. The circuit at Fig. 6 draws only 4 mA. at 12 volts, but provides adequate drive. The r.f. measured at the crystal will drive the probe-v.t.v.m. combination off scale, and if the injection frequency is at the top of the filter skirt, will require only 10 pF. for optimum coupling to the modulator. When the crystal frequency is altered to the 20 db point on the skirt, the coupling capacitor can probably be increased to about 50/130 pF. Some crystals are obstinate starters, particularly if the Q of the output tank is too low. However, I have successfully used conventional i.f. transformer windings, or miniature transistor type i.f. transformers as the tank coil.

At 455 Kc. it is best to listen on or near the crystal frequency for indications that the oscillator is working cleanly, because the d.c. milliamp. meter indication at resonance is a little difficult to interpret.

An identical oscillator circuit is used for the injection oscillator for 8.4 Mc. (or whatever frequency you require).

Because crystal activity and capacity have an effect on circuit values needed for reliable oscillation, it is best to bread-board a basic circuit with which to prove available crystals. Stubborn crystals may require alterations to the bias divider network, feedback capacitor, and emitter by-pass capacitor. Some stubborn low frequency crystals may even necessitate the addition of a feedback winding of a couple of turns through which to couple the crystal between base and collector.

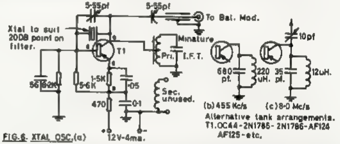


FIG. 6. XTAL OSC. (a)

Alternative tank arrangements.
T1. OC44-2N1785-2N1786-AF124
AF125-etc.

This oscillator must be well under control of the crystal. Distortion will result from any "pulling" of the oscillator by the balanced modulator or from under or over drive. Minor adjustments to frequency can be made by means of the trimmer across the crystal. Too large a value may prevent oscillation. The coupling capacitor should be in the oscillator shield can.

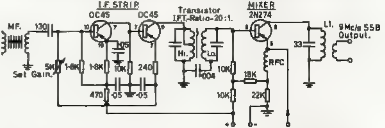


FIG. 7. I.F STRIP & MIXER.

Because the secondary of a transistor type i.f.t. consists of only about five turns, very little 455 Kc. r.f. can be measured at the mixer base. The 5K pot will allow a 2 : 1 change of gain through the i.f. strip, and should be used in preference to the audio gain control. L1 can be link coupled to the receiver to prove correct mixing. Removal of either the 455 Kc. or 8 Mc. drive should eliminate the resultant signal. Normal operation results in about a S7 signal. This is a modification of a Collins circuit, and incorporates three necesary corrections to a previously published circuit.

THE I.F. STRIP

Initially, it was thought that one stage of transistorised i.f. at 455 Kc. would be sufficient. However, the insertion loss of the mechanical filter, together with the comparatively low output from the diode balanced modulator, necessitated a two-stage i.f. strip. The circuit finally used is shown in Fig. 7.

THE FIRST MIXER

One would think that nothing could go wrong with a mixer, however, although they will mix readily, transistor mixers are more critical than their valve counterparts. If unwanted products are to be minimised, oscillator and signal injection levels need to be accurately set, and output circuits kept at as high a Q as possible.

Although I attended to these aspects, I fell into the trap of testing the mixer with 6 volts instead of the design figure of 12, and it was some time before the reason for disappointing results was identified. Also, the idea seems to be to run transistor mixers at very low signal levels, recovering the gain in a subsequent amplifier at signal frequency. An OC171 or AF114 in any convenient r.f./i.f. type amplifier circuit will prove effective.

THE BALANCED MODULATOR

This portion of the project had not been identified in advance as a problem area. In point of fact, it turned out to be the real challenge. Despite a lack of information in the available Amateur literature to suggest that traps awaited the experimenter, it was soon apparent from on-the-air comments that many Amateurs, and some professionals, had experienced difficulty in obtaining proper operation. On the other hand, several Amateurs reported excellent operation at their first attempt.

By nature, the simple diode modulator is a temperamental device. It is temperature sensitive, voltage sensitive, capacitance sensitive, and apparently frequency sensitive. It needs to be operated in a non-linear region so that it will mix audio and r.f. but not so non-linear that it will distort the product.

Although the obvious precautions for bridge balancing were taken, initial results were discouraging. Initially for example, a change of crystal frequency, even by tens of cycles, unbalanced the modulator. If the r.f. level was made even marginally too high, balance could not be regained without a very large increase in capacitance trim. In fact, it was impossible to substitute the alternative crystal needed for opposite sideband operation without requiring a drastic capacity re-balancing of the modulator. This, despite care in layout, a Collins filter as the load, selection of diodes whose forward resistance was matched to within 0.1 of an ohm, and use of the recommended r.f./a.f. ratio of 6 : 1.

After much on-the-air experimenting, and discussion with knowledgable sidebanders such as VK2BK, it was realised that the amount of carrier passed through the mechanical filter was drastically affected by the relative position of the injection frequency on the filter passband. For example, a crystal only tens of cycles up the skirt from the desired 20 db point in the slope provides a voltage which may well be half a volt in three in excess of the value obtained from its companion crystal correctly placed on the opposite skirt of the filter. The bridge must therefore be capable of suppressing this increased level of carrier.

The effect may also be appreciated by considering that if the carrier is placed at the centre of the filter response plateau the result will be a.m., with the unwanted sideband being progressively reduced as the carrier frequency is edged over the edge of the plateau. With almost vertical skirt response, a very small change in frequency then causes a very large change in output from the filter. The closer the carrier frequency to the plateau, the better the carrier cancellation demanded of the balanced modulator and the better the diodes that are needed. The final injection frequency is therefore very much a matter of choice, being a compromise between optimum suppression and desired audio characteristic.

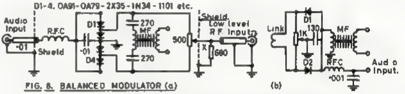


FIG. 8. BALANCED MODULATOR (a) (b)

The normal bridge arrangement has been drawn differently to minimise the risk of incorrectly wiring the diodes. The 270 pF. mica capacitors resonate a Collins filter. Fig. 8(b) shows an alternative arrangement.

The correct spot can be found by use of the BC221, monitoring the resultant in the receiver and adjusting the injection frequency until a slightly high pitched audio results. It will be necessary to use an attenuator, Fig. 5 (a), to set the optimum signal level from the BC221. A stable b.f.o. type oscillator can then be set to the frequency indicated by the meter, or a crystal can be adjusted to provide the desired frequency. Note that during adjustment every change in carrier frequency will probably necessitate re-balancing of the bridge. If these effects cannot be overcome, they can be minimised by the use of separate carrier oscillators for each sideband.

Turning again to the diodes, and granted that there is a wide range of temperatures in Canberra in winter, 1N297As quite definitely showed the adverse effect of 30 degrees of temperature change. This required up to an extra 40 pF. across one arm of the bridge to regain balance (the resistive value remains almost unchanged).

From advice subsequently received, it seems that computer type diodes, such as the gold-bonded OA5 and OA7, are not so prone to these effects, OA79s and OA91s and Fairchild 1101s are also well regarded. Regardless of the type of diode used, all will have an optimum r.f. voltage (allegedly about 5 volts) at which best mixing occurs. Apparently all will be intolerant of unduly high (or low) input levels. The trick therefore seems to be to choose r.f. and audio input levels which best suit the diodes in use. Laboratory equipment is needed to measure low r.f. voltage levels accurately, but fortunately in practice the proper level can be decided by listening tests, whilst progressively adjusting the r.f. input.

As it is somewhat distracting to chant "hello test" for long periods, I recommend placing a broadcast receiver close to the microphone and then leisurely adjusting the balanced modulator for best recovered audio. (If the balanced modulator is "pulling" the carrier oscillator it will be impossible to recover clean audio.) If music sounds reasonable when converted to s.s.b., speech will be first class. Very little audio is needed for best operation. The curve at Fig. 5 (b)(1) was taken with an 0.01 uF. capacitor at X, as recommended by Collins. However, superior results were obtained without it.

Two circuits are given in Fig. 8 from which to choose and experiment. Many Amateurs have had success with each. The choice depends largely on the method used to transfer r.f. from the carrier oscillator. Link coupling is particularly attractive, requiring about 5 volts r.f. across the link for best operation. The modulator should not subsequently need re-adjustment when the linear is made operative. If it does, this is an indication of carrier leakage, r.f. feedback, or regeneration.

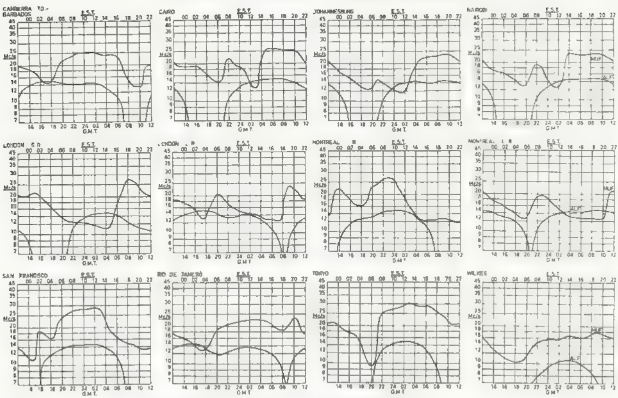
LAYOUT

Interconnection of the various sub-chassis presents no problems. As with valve equivalents, the use of shielded d.c. wiring and feed-through capacitors is advantageous. Normal layout principles suffice. It will be found possible to mount all the stages described in a box which is large enough to contain a v.f.o. and associated slow motion dial. There will even be room for an additional amplifier stage at 9 Mc. should this be found desirable. Because the required v.f.o. frequencies depend on the choice of sideband generator frequency and vice versa, this aspect will not be discussed, other than to suggest the use of an oscillator and emitter follower such as used in the Swan 350, or described in "Amateur Radio" in February 1964.

Due to the low r.f. levels around the balanced modulator, difficulty may be encountered if an attempt is made to operate in a strong r.f. field such as exists near linear tank coils, or in circumstances where a high s.w.r causes r.f. "hot-spots" on the chassis. These difficulties are minimised by layout, shielding and by-passing.

(Continued on Page 17)

PREDICTION CHARTS FOR FEBRUARY 1967



(Prediction Charts by courtesy of Ionospheric Prediction Service)

BUFFER STAGE

Readers may wonder why this project has been interrupted at a low level stage and why the remaining outboard v.f.o. mixer and subsequent buffer-driver have not been transistorised. They could be, but for home station use there is little point. All the stages described can be operated economically from one or two lantern batteries. The 300 volt supply is still needed for other purposes such as linear screen supply, buffer plate supply, bias, vox relay, etc., so there is little point in using additional transistor stages whose d.c. requirement is going to run into an amp. or so and necessitate use of a car battery or another a.c.-d.c. supply. Furthermore, the last mixer necessarily operates at a relatively high level and at this stage of development a balanced design is preferred so as to minimise the risk of spurious product frequencies. The 12AT7 circuit at Fig. 9 is well proven in this role and is therefore retained for the present.

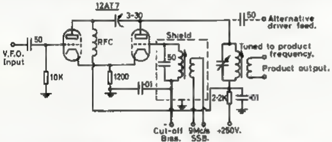


FIG. 9. FINAL MIXER.

The 9 Mc. input coil should be shielded. After the product frequency has been identified and the plate tank peaked, the receiver is tuned to the v.f.o. frequency and the 3-30 pF. "phasing" capacitor adjusted for minimum received signal.

TRANSISTORS

Finally a word about transistor types. Because stage gain is proportional to frequency, it is hopeless to expect audio-rated transistors to operate effectively at radio frequencies. Fortunately r.f. transistors will operate at audio frequencies. Therefore the important ratings to consider are the intended operating frequency, and the intended maximum operating voltage, choosing the cheapest transistor which will fit these limits.

If a milliamp. meter is inserted in the supply line for the initial "smoke test", there should be no chance of accidentally damaging a transistor by allowing excess current to develop excess temperature. Note, however, that the application of excess voltage from any cause (including violent self-oscillation) can instantly destroy the gadget. Therefore regard voltage ratings as "never-exceed" values. The stages described to date are not operated near their critical ratings hence transistor substitution, within reason, should present no problem. Table 1 shows a general basis for substitution.

The frequency F is that at which the gain will fall to reference level. Therefore as a basic rule, always choose a transistor for r.f. amplification whose recorded characteristic of f_{α}, $f_{\alpha b}$ or $f_{\alpha e}$ is at least treble the intended operating frequency. Vmax is the maximum voltage permitted between emitter and collector.

SUMMARY

Although this project was started as a means of learning about transistors, it quickly developed into a typical radio project. Transistors as such, proved to be the least problem. Techniques already common in Amateur Radio proved entirely adequate and at no stage was it necessary to dig far into transistor theory and application. In fact it wasn't even necessary to use Ohm's Law! The project showed that seemingly complicated projects can be successfully completed with normal Amateur know-how and co-operation.

As with the phasing rig project in 1959, it was only necessary to get a signal on the air to obtain ready help from others who had trodden a similar path. The satisfaction resulting from successful completion (?) of the project makes the time spent on it seem negligible.

Others contemplating similar projects will be re-assured by the knowledge that there are now more than 825 VK Amateurs active on sideband, many of whom are well qualified, and willing to share their experience with others.

Task	Type Used	Family	mW.	Vmax.	Freq.
Speech Amp.	2SB54	PNP (a.f.)	80	25	1 Mc.
Vox Amp.	2N280	PNP (a.f.)	125	20	300 Kc.
9 Mc. i.f.	OC171	PNP (r.f.)	50	15	70 Mc.
455 Kc. i.f.	OC45	PNP (i.f.)	80	15	3 Mc.
455 Kc. osc.	OC44	PNP (osc.)	43	15	15 Mc.
8 Mc. osc.	2N374	PNP (r.f.)	80	40	30 Mc.
Mixer	2N274	PNP (osc.)	80	20	30 Mc.

Table 1.

SCHEMATICS

Figures shown around the transistors indicate d.c. voltages on the base, collector and emitter.

ACKNOWLEDGMENTS

The majority of the 7 Mc. gang have helped at one time or another with useful reports. Special thanks are due to those who gave extra time to listen to tests and offer on-the-air advice. Without this, the project might never have been so successful.

Basic ideas for suitable circuits came from Collins, Philips and Mullard bulletins, and manuals such as the "CQ" Sideband Handbook and the Transistor Radio Handbook, now advertised in the magazine.

AMATEUR FREQUENCIES:
USE THEM OR LOSE THEM!

NON-DELIVERY OF "A.R."

If you are not receiving your copy of "A.R." please follow these steps which will ensure the correct procedure is followed; any attempt to short circuit the system will only further delay matters.

Write to your Divisional Secretary advising non receipt of "A.R."; do not write to "A.R." The Divisional Secretary should write to the Circulation Manager "A.R.," P.O. Box 36, East Melbourne, C.2, Vic., advising him of the problem. Unless this advice is received before the 8th of the month, a further month must elapse before the member can be re-instated upon the circulation list.

Please ensure that you always advise your Divisional Secretary in writing, verbal advice will not do.

TECHNICAL ARTICLES

Readers are requested to submit articles for publication in "A.R.," in particular constructional articles, photographs of stations and gear, together with articles suitable for beginners, are required.

Manuscripts should preferably be typewritten but if handwritten please double space the writing. Drawings will be done by "A.R." staff.

Photographs will be returned if the sender's name and address is shown on the back of each photograph submitted.

Please address all articles to the
EDITOR "A.R.,"
P.O. BOX 36,
EAST MELBOURNE, C.2,
VICTORIA.


FR-50
FL-50
Single Side Band

SIDEBAND

Sub-Editor, PHIL WILLIAMS, VK5NN

This month it is desirable to avoid, again, the use of diagrams in the sideband notes, because of holidays and other matters which make their preparation difficult with the time and facilities available

Since we are soon to have a new set of regulations governing Amateur operation and the impact of these on "Sideband" will soon be felt, I am going to commence discussions on linear amplifiers, in which will be included the long promised survey of input circuits for grounded-grid amplifiers, so that those who have requested this will not have to wait long.

A general discussion to give people the feel of what this linear amplifier busness is all about, will not go amiss, as this will give some of the reasons for treating certain aspects of amplifier design and operation in greater detail than others which have been familiar to the Class C amplifier brigade.

The P.M.G.'s Dept. has recently written to the W.I.A. asking for comment on proposals for the 400 watt p.e.p. (output) rating for s.s.b. equipment. which will bring Australia into line with the British method of rating.

To explain why this rather generous looking figure has been adopted we must remember that human speech, which is what Amateurs are permitted to transmit in the A3a mode. is a combination of many sinusoidal tones transmitted in somewhat orderly chaos. The generally orderly pattern is recognisable as human speech, but the chaos is to be found in the numerous combinations of tones and their phase relationships, which build up the complex waveforms we know as speech. Even though the amplitude of any one of these tones may be small, the combination of many tones in the right phase relationship, can produce peak amplitudes having quite high values.

The problem of assessing the value of the peak is a rather complex one which is well known to communications engineers designing multichannel systems. Basically, every time the number of tones to be transmitted by a system is doubled, the capability of the system to transmit the signals supplied to it must be increased by 6 db. Conversely, if a system has a known single-tone capability and is required to transmit multi-tone signals, then the amplitude of each must be reduced by 6 db each time the number of tones is doubled. This is a theoretical value which holds up to about 6 or 8 equal tones, but when the signal contains about 30 tones the practical peak falls short of the theoretical by about 9 db. due to the fact that they are not all likely to be "rising" at the same instant, to produce the theoretical peak.

We have been discussing peak values, not RMS values, but here I would like to mention the special case of the 2-tone RMS power test. The RMS power (thermal power in a load resistor) will increase by 3 db each time the number of tones is doubled. This gives us the basis of the proposed method of measuring power output from an s.s.b. transmitter With two equal audio tone input signals to the s.s.b. transmitter the power indicated in an R.F. watt meter is 3 db below the peak envelope power rating of the transmitter. To assess the maximum p.e.p. of the transmitter this should be measured at the same time as the R.F. envelope is analysed for distortion—for which a visual method is most commonly used—i.e. display the R.F. envelope on an oscilloscope while carrying out the power measurement. The visual onset of distortion is usually fairly obvious and sufficiently useful for low-powered Amateur transmitters. For multikilowatt commercial transmitters, more sophisticated methods of measuring distortion are used, such as spectrum analysers capable of indicating distortion products as much as 120 db. below the desired output frequencies.

The human voice gives intelligible signals over an electrical circuit if its response is limited to a frequency range of 300 cps. to 3000 cps. Further restriction may result in loss of intelligibility which may be tolerable under Amateur DX communication conditions, where you know pretty well what you want to hear from the other chap, anyway. Call sign, handle, QTH. QSL? and several numbers to give a signal report—and you have another country! For an s.s.b. signal we simply pick up this bundle of frequencies as they come from the audio amplifier and translate them up to the R.F. band we are using, by adding on the carrier frequency (sometimes. for lower sideband, we subtract them from the carrier frequency) and then we amplify this band of R.F. signals to the desired level and apply them to the antenna system.

For public address work we amplify the signal as it stands and apply the original frequencies to a loud-speaker system. The only difference between the audio and s.s.b. amplifiers is that the relatively small percentage bandwidth of the s.s.b. amplifier enables us to use tuned circuits as loads, and the tuned circuits permit single-ended amplifier operation instead of "push-pull" which is essential for the high-powered audio amplifier (unless you like using 852 triodes in class A).

The above analogy is given so that the mystery surrounding the linear amplifier and its operation will not cause a mental "freeze". If you look at the Class B operating data for transmitting tubes as modulators the same pair of tubes either push-pull or in parallel in R.F. circuits, will deliver the same output. The limitations of ratings with frequency will still apply as for R.F. Class C duty, and such complications as neutralisation and screening are still needed, but currents, voltages, driver impedances, plate H.T. supply regulation, and the duty cycle for speech operation in modulator service with ICAS ratings. will still apply for s.s.b. operation. Correct plate impedance matching is just as essential for peak output as it was in modulator service, and operation with the correct quiescent current will reduce distortion in an s.s.b. linear in the same way as it reduced "crossover" distortion in the modulator.

The main point to be understood after reading as far as this, is that s.s.b. signals are just like audio signals. Their average power is low, their peak power may be high, low distortion amplifiers, operating in Class A at low levels. Class AB1 at medium levels, and Class B at high levels, are used for their amplification. The new P.M.G. regulations will allow us to instal equipment capable of providing a peak output level of 400 watts of R.F. It is not necessary to provide all the power transformer to operate at this level continuously as normal speech has a low duty cycle. But it is necessary to use Class B amplifier tubes which will give the emission (from filament or cathode) and which will operate at the high plate voltage, and which have sufficient plate dissipation to cope with the quiescent (no drive) conditions, to give low distortion output at the peak output rating. Remember too, that Class B amplifiers are rarely more than 60% efficient, the tank circuits are lossy (particularly on 10 and 15 metres).

The transmitter final will have to contain high emission tubes operating at high plate voltages—cf a 150w. a.m. transmitter on modulation peaks. You should operate these with fairly high quiescent current and voltage, but just loafing along as far as the meter readings on speech are concerned. Conservative operation means that you will not be hitting the peaks too often and will, therefore, have a clean signal.

Imagine your voice as though it were, say, 16 five watt signals (at radio frequency) all on different frequencies, stopping and starting and changing all the time, to provide the intelligence you wish to convey. The average power (output) of this combined signal could be about 80 watts (this corresponds to a modest input to the plate) but the peak would be about 400 watts of peak R.F. envelope power.

The linear amplifier to do this can be designed into less than 1 cubic foot of case—but the 150 watt a.m. final plus modulator would most certainly take a lot more space and power from the mains.

Let's settle for sideband!

73 for now, Phil 5NN.

I.T.U. FUND ACKNOWLEDGMENTS

Canberra Radio Society	$10.00
Harvey, C. G., VK1AU	$2.00

NEW CALL SIGNS

SEPTEMBER 1966

VK2AWU—W. A. P. Luke, 2/286 Maroubra Road, Maroubra.
VK2BEC/T—C. E. Crowe, 255 Bent Street, South Grafton.
VK2BON—M. C. Cain, 53 Floraville Road, Belmont North.
VK2BRF—R. C. Fosberg, 34 William Street, Hornsby.
VK2ZEZ—J. L. Jones, 1 White St., Darling Point.
VK2ZHI—J. Pollock, 15 Mathew Parade, Blaxland.
VK3LM/T—J. A. Wilson, 14 Merrilong Street, Ringwood East.
VK3TY—J J Martin, Lot 264 Wellington Road, Springvale North.
VK3AEZ—A. W. Stewart, 12 Trevatt Court, Mildura.
VK3AMB—M. A. Taylor, 55 Bronte Street, Heidelberg.
VK3ANU—D. C. Diamond, 49 Fewster Road, Hampton, S.7.
VK3ZHU—A. G. Moritz, 7 Wadham Street, Pascoe Vale South.
VK3ZJS—D. A. Stewart, 74 Wilson Street, Wodonga.
VK3ZKZ—G. W. Van Galen, 13 Clivedon Court, Leopold.
VK3ZQN—J. W. Nott, 14 Garnet Leary Avenue, Black Rock.
VK3ZQT—D. R. Martin, 36 Maidstone Street, Altona.
VK3ZSX—S. F. Lane, Orchard Drive, Croydon.
VK3ZTQ—C. Quain, "Tiamaree," Doongalla Road, The Basin.
VK3ZUH—A. K. Hore, 63 Kitchener Street, Broadmeadows.
VK3ZVL—D. G. Long, Kettles Road, Lang Lang.
VK3ZVP—L. Kurcki, 18 Boort Street, Broadmeadows.
VK3ZVR—E. A. Van Rhijn, 12 Evans Crescent, Laverton.
VK3ZXA—D. L. Mitchell, 17 Mabel Street, Camberwell.
VK3ZXC—L. A. Costa, 23 Little Myers Street, Geelong.
VK3ZXE—A. R. Smith, 11 Levuka Street, Seaford.
VK3ZHJ—J. E. Brown, 23 Montgomery Street, Wendourse, Ballarat.
VK3ZYS—S. H. Barber, 36 Olympiad Crescent, Box Hill.
VK3ZZA—P. T. Ament, 32 Brinkley Avenue, Ballarat.
VK3ZZE—R. S. Elkin, 6 Windsor Avenue, Charlton.
VK4BS—Toowoomba Guide and Scout Radio Club, Postal: P.O. Box 106, Town Hall Post Office, Toowoomba. Station: Rangeview Scout Hut, Picnic Point, Toowoomba.
VK4CT—R. G. Graf, 10, 26th Avenue, Palm Beach.
VK4IX—L. J. McIlree, 253 The Esplanade, Cairns.
VK4KE—T. J. Fishpool, 80 Jellicoe Street, Toowoomba.
VK4PP—N. L. Martin, Station: Point Cartwright Drive, Biddina Beach. Postal: Wallace Street, Bell.
VK4QM—C. A. Miller, 26 Grigor Street, Moffat Beach, Caloundra.
VK4SR—G. N. Scott, 31 Bassett Street, West Chermside.
VK4ZEG—E. F. Gill, 22 Westbourne Street, Townsville.
VK4ZKW—K. L. Watson, 53 Merthyr Road, New Farm.
VK4ZPC—P. D. Crewdson, 33 Hansen Street, Moorooka.
VK4ZSB—R. J. Stroud, 106 Dorrigo Street, Kedron.
VK4ZSC—R. A. Chernich, 26 Atkinson Street, H[illegible]
VK4ZWD—W. D. Metcalfe, 23 Westbourne Street, Hermit Park, Townsville.
VK5DI—W. T. Lucas, 27 Butler Street, Elizabeth Park.
VK5PL—D. M. Roberts, C/o E. S. & A. Bank, 238 Main Road, Blackwood.
VK6ZBI—L. P. Priest, 113 Hampshire Street, East Vic. Park.
VK6ZEN—N. R. Dowie, 6 Hilda Street, Shenton Park.
VK7FB—M. L. Jenner, 228 Bathurst Street, Hobart.
VK9KS—K. S. Smith, Station: 3 Modilon Road, Madang. Postal: P.O. Box 46, Madang.
VK9RI—R. M. Inwood, Station: Moru Street, Boroko. Postal: C/o O.T.C., Box 56, Port Moresby.

OCTOBER 1966

VK1BC—B. H. Christensen, 1 Bosch Place, Chifley.
VK1DS—D. J. Slade, 7 Robert Campbell Road, Duntroon.
VK2WG—Wagga District Radio Club, Station: 33 White Street, Kooringal. Postal: Wallace Street, Coolamon.
VK2BJF—P. J. Fackender, Flat 1, Lot 4, McDonogh Estate, Princes Highway, Dapto.
VK2BJS—J. B. Stary, Station: Panorama Road, Calala, Tamworth. Postal: RMB 829C Tamworth.
VK2BRT—R. B. Tice, "Old Castle," Leadville.
VK2ZHX—A. J Leo, 319 Old Kent Rd., Greenacre.
VK2ZNP—G. C. Burge, 157 Mitre Street, Bathurst.
VK2ZPH—P. J. Shannon, Flat 5, 263 Johnston Street, Annandale.
VK2ZWC—W. F. Cromarty, 560 Buchhorn St., Albury.
VK2ZWX/T—J. A. Wilkinson, 46 Franklin Rd., Orange.
VK4BL—A. F. Jacobsen, Station: 35 Kilkivan Avenue, Kenmore. Postal: Box 61A, G.P.O., Brisbane.
VK4CM/T—T. M. B. Elliott, 34 Esplanade, Burleigh Heads, Gold Coast.
VK4OO—M. Blackstone, 384 Fig Tree Pocket Road, Fig Tree Pocket.
VK4ZAM—A. A. S. Millard, 26 Beaton Street, Mackay.
VK4ZDD—D. L. Dwyer, 67 Pring Street, [illegible]
VK4ZHO—R. J. Hoare, 16 Wendover Street, Grovely.
VK4ZLZ—D. J Connolly, 26 Stanton Street, Belgian Gardens, Townsville.
VK4ZRP—R. Pearson, 10 Kenberry Street, Brighton.
VK5HF—G. Harman, Portable in S.A. Postal: C/o O I.C. Aerodrome, Ceduna.
VK5QX—I. J. Hunt, Portable in S.A. Postal: C/o P. Longhurst, 6 Northampton Crescent, Elizabeth East.
VK5ZJN—J. C. Newgrain, 37 Para Street, Salisbury.
VK6DE—H. G. Austin, C/o O.T.C. Carnarvon.
VK6DS—P. A. Smith, 21 Floyd Street, Triggs.
VK6ZET—P. J. Taylor, 82 Connolly Street, Wembley.
VK6ZGE—J. V. Delane, 146 High Road, Melville.
VK7WH—W. J. Henry, 642 Nelson Road, Hobart.
VK7ZCP—C. S. Perger, 37 Galvin Street, Launceston.
VK7ZJV—J. J. Vangalen, 7 Rufus Street, Gowrie Park.
VK7ZTH—A. T. Head, Flat D, 4 Robert Street, West Hobart.
VK7ZXT—A. I. Bedelph, 43 Smith Street, Smithton.
VK0CR—R. D. Champness, Macquarie Island.
VK0CS—C. Simpson, Mawson.
VK0GP—G. N. Payne, Wilkes.
VK0TO—T. Olrog, Wilkes.

OBITUARY

BOB MEADOWS, VK2IN

Bob passed away on December 7 after several years of ill-health at The Entrance. A few weeks previously he had been active on 7 megs. using a Swan 240, from Terrigal. He was born in England and was in radio-electrical retailing before the war. During the war he served in the R.A.A.F. as Communications Officer. In 1946 he joined Mingays Electrical Weekly as radio technical editor During 1957 and 1958 he toured most of Australia and operated VK2IN from his caravan, while calling on thousands of radio retailers and broadcasters for his magazine.

In retirement he took a great interest in the Gosford Radio Club and lectured to A.O.C.P. classes. Bob's report on a transmission was accurate and well worth asking for. He will be missed by his many, many friends. He leaves a widow, son and two daughters. To them we extend our sincere condolences.

ALF. SCHOFIELD, VK6TS

It is with regret that we record the passing of VK6TS, Alf. Schofield. An Amateur of 38 years' standing, born in England, he came to VK6 five years ago and was active on 40 and 80. He ran a business at Northam and lived at Kenwick in the metropolitan area. He died on October 12 last and Amateur Radio lost a very likeable person in Alf. The Institute, in fact all Amateurs, extend to his wife, son and daughter our heartfelt sympathy.

Vale Alf.

CENTRAL COAST BRANCH
N.S.W. DIVISION. W.I.A.
GOSFORD FIELD DAY
FEBRUARY 26th.

W.I.A. 50 Mc. W.A.S.

Call	Cert. No.	Addt. Cntr.	Call	Cert. No.	Addt. Cntr.
VK4HD	27	5	VK5ZEJ	67	2
VK4ZAZ	36	5	VK3WK	68	2
VK4ZBE	38	5	VK5LC	1	1
VK3ZFM	23	4	VK6DW	3	1
VK3ZHF	28	5	VK2AEZ	10	1
VK3IM	30	4	VK3XA	11	1
VK8AU	32	4	VK3GM	13	1
VK4PU	35	4	VK3ACL	14	1
VK2ABR	40	4	VK2HO	17	1
VK5BE	65	4	VK3ZEA	18	1
VK4ZGL	70	4	VK7ZAQ	24	1
VK4HR	4	3	VK5ZBR	27	1
VK2PG	5	3	VK5KO	42	1
VK2ABC	8	3	VK3ZGP	51	1
VK2VW	9	3	VK3ZIG	54	1
VK3GG	19	3	VK4ZEK	56	1
VK5ZAX	20	3	VK5ZDS	60	1
VK5CL	21	3	VK5WV	64	1
VK5BQ	23	3	VK6ZCX	69	1
VK7LZ	34	3	VK2ZKW	73	1
VK3QV	39	3	VK[illegible]	75	1
VK4ZK	53	3	VK2ZML	76	1
VK4ZAL	58	3	VK2ZDP	77	1
VK5EK	61	3	VK2WH	15	—
VK5ZGF	63	3	VK5AX	36	—
VK4RY	2	2	JA1BYM	43	—
VK3ZGZ	26	2	JA4IO	44	—
VK5ZZ	31	2	VK4ZAA	46	—
VK7ZAO	33	2	VK6ZAA	47	—
VK5ZMK	38	2	VK5ZSG	52	—
VK3ZGM	40	2	VK6ZCM	53	—
VK3ME	41	2	VK8ZCX	59	—
VK2ZCF	48	2	VK6ZAS	62	—
VK4ZLG	49	2	VK8ZDI	71	—
VK2ASZ	50	2	VK2ZRU	72	—
VK1VP	57	2	VK4ZPL	74	—
VK7ZAP	66	2			

Correspondence

Any opinion expressed under this heading is the individual opinion of the writer and does not necessarily coincide with that of the publishers.

"SERIES" ANTENNA

Editor "A.R.," Dear Sir,

I refer to a letter by Col. A. McKenzie in "Amateur Radio," January 1967, which first of all states that the title of an article by me in "A.R.," October 1966 is "incorrect and misleading." Other matters are also raised in relation to certain technicalities.

I cannot subscribe to his statements in any way and suggest that he do a little re-reading in which the antenna radiates. He mentions antenna gain but did not in one instance give any practical results on the operation of his array.

At this stage I do not wish to bore readers with any more remarks on the "Series" antenna other than to say that it is strictly a one-band affair and in view of further developments the "Series" antenna is now considered redundant and relegated to the junk heap.

I have devised another antenna which has the distinct advantage of two-band operation and of which I have forwarded full details to you for publication.

—Wal E. Salmon, VK2SA.

PEN FRIEND REQUIRED

Editor "A.R.," Dear Sir,

During a recent contact with HB9AFI I received a request for a VK Ham with whom the operator could correspond. I wonder if you could arrange a small paragraph in the most appropriate place in "Amateur Radio" to assist? The details are as follows.—

HB9AFI, Kurt Wetter, age 25 years.
Sablons 4,
Lausanne/VD, Switzerland.
Equipment. National NCX-5, Ant. G5RV.

I don't have time to keep up a regular correspondence, and am nearly twice his age!

—Ralph J Knight, VK5NK.

"THE PRIMITIVE ART"

Editor "A.R.," Dear Sir,

In "Federal Comment" in "A.R.," September 1966, Peter Williams VK3IZ made some pertinent remarks as to the part c.w. (A1 mode) has played up to the present in the ever enlarging field of Radio Communication and its chances for the future. Sadly, it would appear that many who read the comment did not understand its implications. Or is it that the "knockers" just can't help themselves in alluding to the c.w. men as antiquated adherents of a "primitive art."

I repeatedly hear on the bands (including the Z boys who should be the last to make voice) derogatory remarks as to so and so and his old A1 mode. All the same sarcasm comes up in direct conversation and in the mail. I have been asked why I persist with c.w., as if its pursuance is something that is not now acceptable in the best Amateur Radio circles any more. A VK5 has written to say that Amateur Radio now has three groups—s.s.b., v.h.f. and the dregs.

Let me here make a qualification. I am not referring to the good-natured banter between c.w. and s.s.b. men, but to the insinuating "talk down" attitude of the persistent knocker, who in this regard suffers from a disordered psyche and finds it necessary to destroy what he cannot conquer. A neatherandal turn of mind—or the real primitive.

While the next I.T.U conference may well bring changes that could affect A1 mode, simply because change is the order of all things, I cannot visualise c w. becoming a mode of the past for a considerable time yet. Certainly never will it become known as a primitive art.

The pro. c.w. man turned s.s.b. devotee seldom if ever makes a derogatory comment. He knows too well what proficient c.w. operating really is.

And what is it?

It is the mode that permits a circuit when all else fails. (Those s.s.b. men who disagree with this say it is each man to his mode.)

It's slower than the spoken word but not that much to really fast operators. But it is more accurate. In fact, 100% accurate.

It suffers no dialect difficulty. This is a great advantage over the spoken word. The Queen's English (to name but one language) is mouthed in divers places but parochial dialect often renders it a foreign language. The duck talk men might take a point here and say that some particular fists represent a language right out of this world. Actually bad senders (those whose character formation and spacing is incorrect) don't survive. They are given the message early and steps are usually taken.

Then there's the argument of bandwidth requirements for c.w. as opposed to s.s.b.

And it seems that c w. mode will have its place as R.C. advances to the use of translator satellites and in man's first forays to outer space. Before its decline dot-dash is going to have an awful lot of use.

It would appear that only a very small percentage of aspirants who now take out their Ham tickets go on to become accomplished c.w. operators. This is to be expected as no novice period of operation is required and the new Amateur simply puts aside his key after having primed himself sufficiently to last out the few minutes of code test needed to pass.

To those so unskilled it is a sweaty, exhausting, and dreadfully restrictive process that holds no hope of competence or efficiency. To the apt there's no pain or strain even at 40 w.p.m. No conscious mental juxtapositioning is required to convert code into words. It just occurs—and if one is writing it down it simply flows from the pen to the paper (like the well-known Biro ad.).

Rather than be eventually termed the "primitive art" it may well become termed as a talent or accomplishment of the "elite."

Perhaps I could do no better than to quote KH6UK and W6NLZ. Both men of experience in R.C., they wrote in "QST" some time ago—"Inasmuch as it has the narrowest bandwidth and the lowest s.n.r. requirements, the first contact using each new space communication system that comes along will probably be made on c.w., as was the case with the satellite Scatter and Moonbounce. The skill of the receiving operator at weak signal reception, i.e. the art of digging stations out of mud, can have a great effect on the minimum required s.n.r. for any specified degree of reliability. This is where effectiveness can be bought most cheaply, for it does not cost a cent to train a good operator. In general, the higher one's receiving speed, the more instantaneous his character recognition is likely to be, and the better he will prove to be as a weak signal operator. In fact, the best such men are those who are able to think directly in code, without the necessity for mentally translating into English. It is no accident that the great achievements in Amateur Radio communication have as a rule been made by "old c.w. hands who rag-chew easily at 40 w.p.m."

So if you've progressed to s.s.b. don't become a code knocker. Keep in mind the part c.w. has, is, and will play yet in the future advancement of R.C.

Bear in mind that s.s.b. mode is in for some drastic changes in the coming years.

One of the primitives (or "elite").

—Al, VK4SS.

Publications Committee Reports

Firstly an apology for not publishing a report for the last two months. The pressure of work getting out two issues of "A.R." and the Call Book so close together proved too much for the system. Unfortunately the lack of reports meant no reminder for our scribes, and some overlooked the earlier copy date for January issue and the fact that we do not include notes in February issue.

At our November meeting correspondence was received from VKs 3ACM, 7RG and Bundaberg Amateur Radio Club.

Technical articles were received from VK2SA and VK2BSJ.

The main items of business handled dealt with the Call Book and arranging for the final checking of the proofs before going to press.

The December meeting was pleased to see two visitors, Ron Higginbotham and Peter Williams.

Correspondence was received from VKs 4AT, 4DZ, 5AX and 7LL, whilst technical articles were received from VKs 2ATE, 3UG and 3ALZ.

Being the last meeting of the committee for 1966 only routine business was handled.

VICTORIAN DIVISION

STATE CONVENTION

will be held during

LABOUR DAY WEEK-END

11th, 12th and 13th MARCH

Location:

BAIRNSDALE

Saturday. Dinner starts 6.30 p.m. sharp. Convention meeting starts 8 p.m. sharp.

Sunday. There will be NO transmitter hunts, scrambles, etc. Instead, it is to be a family day. We have chartered the "Tambo Princess" and will spend the day cruising on the Gippsland Lakes. Lunch on board

Monday Free to do as you please.

Accommodation in the area, and capacity on the "Tambo Princess," is limited so early booking is essential. If you have not yet received your notice form giving complete details, phone 34-9387.

VK2 DIVISION

RADIO EQUIPMENT STORE

Happy New Year. Do you have an up and coming junior op. in the shack? Do you find that your half finished projects are being completed for you, but not quite the way you want them? If so, perhaps we will be able to solve the problem for you with one of the kits listed below. (The only danger will be that Junior will learn too much and completely kick you out of the shack.) These kits, which are of New Zealand origin, are supplied to the Y.R.S. Scheme.

Fountain Experimental Science Kits.
Kit 2. Junior Electronic Laboratory
Kit 3. Advance Radio Kit.

Battery power only, complete with a comprehensive instruction book. Limited numbers, so do not delay. $20 per kit, postage included. P.S.: Don't let the XYL read about these or you may have to buy one to keep the harmonics from under foot.

We recently obtained a number of TALBE survival beacon transceiver units. These units are the type used by air crews and form part of their Mae West gear. When the antenna is released the unit automatically transmits a beep tone for d.f. purposes. When the search aircraft is close, the unit is equipped with voice sending and receiving. Consists of two units, one being the antenna and microphone/speaker and the other the transmitter, receiver and tone equipment. Transmitter is crystal locked, in the 120 Mc region. Crystal is removed as it was on an international distress frequency. Receiver is a superregen. 5 wire in battery tubes are used. Could be suitable for conversion to 2 metres, ½ watt output. $5.00 per unit plus 75 cents postage and packing. Weight 3 lb. approx.

We also have the following available:—

Type S power supplies. $26.
Collins ART-13 transmitters. $80.
Cossar Signal Generators, Type 53A, 6 to 52 Mc. $35.
SCR 522 Test Sets. (Sig. Gen., field strength., battery box, in wooden case). $19.
AR7 Receivers. Various conditions. $80 down, according to condition.
The following Receivers (slight mods.) AR88, BC348, AMR300.
Pye Reporters (low band a.m.). $17
Pye Rangers (low band a.m. 6AQ5 p.p. mod., 3/12 final), $25.
Teletype equipment. While much has already been sent interstate a few bits remain. (Melbourne Amateurs should check with VK3ZEO who could give you details about units already in VK3.)

All the above items are F.O.R. Sydney. These orders are assembled and dispatched to our carrier twice a month. Please include a S.A.E. with all inquiries.

Next month there will be details of the coil formers mentioned on page 17 December issue. Make 1967 your building year. We may be able to help out with Vernier dials, meters, multimeters, knobs, co-ax. fittings.

All inquiries for the above should be addressed to:

Radio Equipment Store,
Wireless Institute Centre,
14 Atchison Street,
CROWS NEST, N.S.W.

TAPED LECTURES

26. Short Wave Listening. 60 mins. No slides. Sid Molen, VK2SG.
27. Introduction to Amateur Radio, 35 min. 17 slides. Sid Molen, VK2SG.
28. Transistors in Communciation Receivers. 60 mins. 24 slides. B. Beresford, VK2ABB.
29. T.V. Station Antenna Design, Pt. 1, Structures, types of radiators. 75 mins. 22 slides. John Vanderley.

Have you read the Editorial in December "A.R."? With the theory exam. every six months you will have to be sure of everything before the exam., six months is a long time to wait for the next try. The VK2 Division will be starting a new series of lectures twice a week at W.I.C. Theory and Morse. Remember that the correspondence course is always available. Details obtainable from the [illegible]rse Supervisor, 14 Atchison St., CROWS NEST, N.S.W.

DX

Sub-Editor: ALAN SHAWSMITH, VK4SS
35 Whynot St., West End, Brisbane, Qld.

Local VK activity seems very quiet. No doubt many ardent DXers are away with their families on vacation. However, the rare prefixes are rolling in, both on 20 and 15, with more than one CQ Pacific going a-begging. Conditions should show a steady, if unspectacular improvement as the year progresses. 21 Mcs. may do best in this regard. Already some of the 20 mx ops. are being heard there.

DX-PEDITION TO LORD HOWE ISLAND BY VK5XK

As most are aware, Arch XK5XK spent his vacation at this exotic spot. The trip, in spite of one or two major setbacks, was quite successful, inasmuch as that Arch did not go to make it a high-powered stint but to have a holiday as well.

Arch worked under difficulties the whole time he was there, from November 23 to December 10, 1966. The tuning assembly of the main receiver was damaged in transit, and he was forced to work with a standby rx that had no bandspread. There were other minor troubles and a freak cyclonic "blow" brought down all three antennae. But he did manage between 500 and 600 QSO's almost all on 20 mx and including several countries on both LP circuits. Rig was QRP 40 watter.

The island itself is one of those delightfully "away from it all spots". Some 6½ miles by one-half mile wide approx., and depending on its existence on the tourist trade.

Arch apparently made a lot of W's happy. Many letters have been received saying "at last Lord Howe"—and Arch says one W told him that he took two days off from work to be sure of a QSO?

Now where to next year, Arch OB?

NOTES AND NEWS

Keramedec Islands. ZL1AI is on Roe Is. 14,120 and 14,130 a.m., xtal control. He should be there for a while. Will work cw on this freq.

Norfolk Is. VK9JA is on, using s.s.b. gear. 14,180 but uses other freqs. VK9RH is also on sometimes.

Vietnam. 3W8D has been worked here on 14,220. Says he is not on the banned list and is perfectly legit. No QSL information available.

Amsterdam Is. 14,040 asking that his QSLs be sent via FR7ZD.

Armenia. UG6SG 14,205 around 1330z.

Gabon. TR8AG on daily. 14,140, 2000z. QSL Box 157, Libreville.

Faeroe Is. OY7ML s.s.b. activity around 1300z. QSL W2GHK.

Turkey. TA2AC worked here 14,020 at 1800z. QSL K4AMC. Big sig.

Cameroons. HK1QQ/TJ8 14,020, 1630z, will be active for a year. QSL home call.

Chatham Is. John Washer, who operated from here in 1963 is expected to return and operate during 1967.

Albania. Never were there so many rumours about activity from this spot. I1RB is now trying to obtain permission to put out some activity from here. Specific dates if they come to hand.

Syria. Rasheed YK1AA active again. Did anyone get his QSL from earlier stint (I did not—Al.)

Iris and Lloyd of Yasme Fame. Should be back home now having a well-deserved rest. But they are expected to be hitting the DX train again soon. This time it will be the African continent.

Brunei. VS5MH skeds W1DGJ, his QSL manager, Mon., Wed., Sat. 14,190, 1235z.

Macao. CR9AH is active on 7000 at 1100z.

Indonesia. W0GTA/8F4 now has permission to work W stations. He also will work any who calls him for a brief QSO.

Trucial Oman. Roger MP4TBO has been on almost daily at 1300 GMT on 14,198, listening 5 up, via Longpath. QSL via VE1AKZ.

Gambia. Ray WA6LBP is now signing ZD3G from here. He is a Peace Corps member, and should be here for about another year. He usually operates just below 14,200, listening 14,205-210 after 2000 GMT. He is presently running 60 watts to a dipole, but hopes to have a more elaborate set-up shortly. QSLs via K6ENX, Otto Miller, 3245 Grand Av., Vista, Calif. 92083.

Gabon. Guy TR8AH, a newly active station, has been on 14,024 at 2100 GMT and is a good cw op. QSL via Box 3132, Libreville.

Dahomey. TY2BC is the call of 5N2AAW and AAX. They are active from here nearly every week-end, working mostly Europeans.

Macquarie Island. Rod VK0CR is active on s.s.b. at present. He is on 14,180, listening 14,205 at about 11-1400 GMT almost daily. He is also on 14,060 c.w. at 0700 GMT. QSL via VK7 Bureau, or Greg Johnson, Inglis St., Newtown, Hobart, Tas.

Maldives. VS9MB on daily, 14,056, 1330z. QSL W2CTN.

VU2 QSL Cards. If you have had QSLs returned by ARSI try Box 53, Bangalore.

VS9OC, Masirah Island. QSL to 21 Berwick Cres., Sidcup, Kent, England. Jim is now QRT.

Tokelaus. ZM7FL operated by VR2FF will be active sometime after Jan. 1. QSL to K9OTB.

South Orkneys. LU1ZG has been on 14,200 a.m., listening about 5 kc. up, at 05-0800 GMT on several occasions. QSL via LU4DMG.

Rio De Oro and Ifni. This stint by EA7JQ and EA7GF will most likely be over by the end of January. My official information on this DXpedition says QSL to URE, Box 220, Madrid, **but contributions will not be accepted.** (This might be a condition of licence issue and it may mean that the government concerned is not the first to consider such operations as an endeavour to make petty capital from petty exploitation rather than an Amateur endeavour.—Al.)

Eben Atoll and Cameron Reef will not count for DXCC. Separately that is. Reported as official from A.R.R.L.

Muscat and Oman. VS9OC active 14,200, approx. 2200z.

Sudan. ST2BSS, 14,185, 1900z. It was earlier reported that no licences were on issue from here but this seems legit.

Easter Is. WB2JVD/CE0 is the call now being used from the Isle of Idols. 14,222, 2400z. Also reports to hand of 21 mc. activity.

Comores. FH8CD regularly on s.s.b. at low end of 20 mx phone segment also at low end of 28 Mc.

Wake Is. Several on from here on all bands. Both cw and s.s.b. Take your pick. KW6ED, KW6EJ, KW6DS, KW6ER.

French Somaliland. FL8RA and one or two others are QRV. Both 14 and 21 Mc. Both modes. 1300z or later.

Libya. 5A1TQ on each day on a.m. 14,100, 1630z. QSL J. Best, Box 1098, Tripoli.

Cote D'Ivoire. TU2BK 14,040. Worked here at 2100z.

ACTIVITIES

Dud VK4MY now sporting himself a big beam on 20 mx, worked the following on s.s.b.: HR1KAS, HS1CB, MP4TBO, 5A4TR (YL op.), VE8QG/SU, UD6BV, VQ9AA/A, TG9IA, UL7BF, 6O1AU, 4X4UL, 9V1MY, OD5CN, OD5AI, W0GTA/8F4 (21 cw.), HM1DE, DU7SV, CX1AAC, MP4BDF, ZE5JJ (21 Mc.), CX2CO, CR7LU (14 cw.), 5R8AL, ZC4CL, VS9ALV 14,145, FG7XL, VS9MB, EP2BQ 14,102, 5A3TW and others.

Dud says he worked WN4ENE/KG6 on Guam and after he passed on his QTH as Gold Coast, S.E. Queensland, he was asked what country is that???

Chas, VK4Uncle Charlie, who amongst other things has worked DXCC (confirmed) this past 12 months on about 25-30 watts QRP, reports QSOing the following: 15 mx: F9EA, DJ6BN, FL8RA, I1FOS, ST2AS, Box 244, Pt. Sudan: 20 mx: F9OQ, UV9OM, YA3TNC, 4X4QA, 4S7DA, YJ8BW, SM6AEK, VE1KG, CP5EZ, TI2PZ, HL9KR, HL9TS, K5SBV, XS5JM, 1G5A, CE8EF, HK7UL, FO8BJ, ZL1AI, Roe Island, and more.

Peter VK4PJ reports 20, 15 and 10 mx open. However, the latter is most uncertain. On 14 Mc. these nice ones were worked: VS9ALV, XE1EEI, UA3CA, UA1MU, VP9CP, HR1JAP, XE1GGW, 9Q5HD, OH1PJ, UA1KBW, DU1BF, 9V1LK, I1VUY, VE8QV/SU, UA9YO, VO1FB, VE1OZ, VQ9AX, XW8CA, OA8V, PJ5CE, HC5KA, CE6FX, CN8FC, VP2AA, G3MW, EA8EZ, KP4BAJ, PJ2AQ, HK9KH, 9Y4VT, 5A3TW, SP9ANH, ON4TX, VP8RG, EL2AK, HS1CB, VE0MY, VP9FK, 9M2PO, CT1PQ, VP7OL, YS1AG, SM6AEK, HI8SCE, FW8RC, G3JAF, HR1CN, 6Y5MJ, ZF1GO, YV5CFA and many more. Mostly around 2000z LP and 0000z. On 21 Mcs. 4X4HK, VU2CQ, VS6EK VR2EK, OE1HKW, OE2BSL, G3UMI, OZ3KE G6XP, G3IWV, G3JAF.

Ken VK3TL now has a 50-ft. GP with 8 radials on 20 mx as a standby for his quad and reports it works fb. This month's cw/s.s.b. effort is as follows: FP8CQ, FP8CY, FR7ZI, FY7YM, WB2VJD/CE0 Easter Is., HP1XYZ, LX1SD, PJ2CU, PJ3CD, PJ5CE, UF6KPA, VK5XK/2 Lord Howe, VQ9AR, VQ9BK, YA3TNC, ZF1GC, ZL1AI Kermadec, 1G5A Geyser Reef, 3W8D, 5Z4JH and 5Z4SS.

Best QSLs received: XF1EP, VS9KRV Kamaran, GD3RWF, VK0MI, 5W1AX, VP2VC, GC2FMV, GC4LI, GC3KFW, GC5ACH, KC6SZ, KG6SZ, EA8EZ Canary Is., IP1AA, I0FGM, CN8BB, ZL5AA, 6Y5DW, ZB2AK, 6O6BW, GW5YQ, FP8CQ, CT2YA, CT3AU, VP8HZ, Falkland Is., 5N2AAW.

QTH's (By Courtesy Ken, VK3TL)

1G5A—W4ECI.
VQ9AR—WA8GUA.
FP8CQ—W4GSM.
WB2VJD/CE0—K8GOT.
FY7YM—Box 63, St. Laurent, Cayenne.
YA3TNC—W3TNC.
3W8D—Russell Milroy, c/o RMK/BRJ 340 A.P.O., 96312, San Francisco.

SUMMARY

Forty Meter Lament.

Often when struggling with the layers of QRM on this band or trying to find an unoccupied cycle into which I can slide a CQ, I begin to ponder on the decline of this band. The truth is that 7 Mcs. is a remarkably fine band for DX, but now the rare ones it seems seldom appear—suffocated under layers of Europe and Asian and commercial QRM. Between 1600z and 2100z this band is usually open to all points west. Sometimes as far as LP to U.S.A., but the intense European intercountry QRM renders QSOs impossible. One wonders also how many of these commercial stations that inhabit the first 20-30 Kcs. of the band are legitimate or bootleggers.

We are told by our Federal and International advisers not to wilt under this mountainous layer of power QRM, but the stage has been reached whereby during these early morning hours there is but a few Kcs. left that are free from this type of interference. And these are so packed with so many European and Asian Hams struggling for QSOs that long distance contacts are well nigh impossible. This cw segment of 7 Mcs. has not gone yet, but the hammer of foreclosure is raised and its going—going—?

I'm typing this particular paragraph off the cuff, but if my memory serves me correctly our good President, L. Blagborough, VK4ZGL, sent out forms not long ago asking that any non-Ham activity be noted and forwarded. I don't believe he received one reply. 'Nuff Sed !!

My thanks to the month's contributors, LIDXA, Fla. DX'er, VE3FXR, G3UGT, VK4PX, VK4DY, VK4UC.

DX es 73. Al, VK4SS.

* * *

R.D. CONTEST

Correction and Addition

G. Earl, L7138	844 points
VK5JT	73 points

CANBERRA CONVENTION

The annual Convention of the Canberra Radio Society will take place during the Friday, Sat., Sun. and Mon. of the 1967 Easter week-end. The venue this year will be the new Griffin Centre in the heart of Canberra. This is a modern brick building, air-conditioned, with all conveniences and unlimited parking. It is situated a few yards from the shops, restaurants and other amenities of the Civic Centre.

Visits are being arranged to a satellite tracking station, Mt. Stromlo Observatory, and a deep space tracking station, also to the National University and other places of technical interest. For the non-technical Canberra offers a wealth of attractions for the visitor.

Competitions and contests will cater for the Hams, S.w.l.'s, the ladies and children, with appropriate prizes. These will be held in conjunction with the picnic lunch at a new and different beauty spot.

The social highlight will be the Convention dinner and reception, to be held this year at the Hotel Canberra on the Saturday evening.

It is essential that intending visitors book accommodation as early as possible. Write to the Canberra Radio Society, Box 1173, Canberra City, marking the envelope Easter Convention and setting out the type of accommodation and price range required. The range is from a suite in the big hotels down to the floor of our old clubroom for the hardy types, but please write soon.

Convention registration remains at $1, payable on arrival, and the dinner is $3.25.

If you're not sure if it will be worth it just ask someone who's been before, and don't forget it's a family affair.

ERRATA

Re article "Propagation of Amateur Signals allied with Ionospheric Predictions." January 1967, "A.R."

The words at the top of Figs. 3a; 3b; 4a; 4b; 5a and 5c which are indistinct should read—SUNSPOT MINIMUM ——.

In column 2 on page 6 the last line should read "VK2WI broadcasts from Dural on 7 Mc. were, etc."

Since the article was prepared some new information has been issued by Zurich which amends the information in column 2, page 2, and reads:—

Beginning with 1966 our predictions were based on the following assumptions:

Date of coming sunspot maximum 1968.7
Highest smoothed monthly sunspot number 100

Now improved predictions can be given:

Date of coming sunspot maximum 1968.5
Highest smoothed sunspot number 110

☆

CONTEST CALENDAR

4th-5th February—33rd A.R.R.L. International D.X. Competition (Phone)—1st week-end.

4th-19th February—A.R.R.L. Novice Round-up.

11th-12th February — John Moyle Memorial National Field Day Contest.

18th-19th February—33rd A.R.R.L. International D.X. Competition (C.w.) — 1st week-end.

18th-19th February—R.S.G.B. First 1.8 Mcs. Contest.

4th-5th March—33rd A.R.R.L. International D.X. Competition (Phone)—2nd week-end.

18th-19th March—33rd A.R.R.L. International D.X. Competition—2nd week-end.

W.I.A. D.X.C.C.

Listed below are the highest twelve members in each section. Position in the list is determined by the first number shown. The first number represents the participant's total countries less any credits given for deleted countries. The second number shown represents the total D.X.C.C. credits given, including deleted countries. Where totals are the same, listings will be alphabetical by call sign.

Credits for new members and those whose totals have been amended are also shown.

PHONE

VK5MS	314/335	VK4HR	261/277
VK3AHO	313/325	VK2JZ	259/274
VK5AB	300/314	VK3TL	249/253
VK6MK	298/315	VK2ADE	223/237
VK6RU	296/319	VK2AAK	221/225
VK4FJ	275/292	VK2APK	217/220

C.W.

VK3KB	318/341	VK2EO	279/300
VK2QL	295/315	VK2AGH	276/289
VK2ADE	291/313	VK3NC	266/266
VK3CX	291/312	VK3ARX	261/269
VK4FJ	287/309	VK6RU	251/272
VK2AHQ	281/293	VK3XB	248/261

Amendments:

VK3YL	241/256	VK3TL	243/246
VK3RJ	232/245		

OPEN

VK2ADE	305/329	VK4HR	279/301
VK2AGH	305/323	VK2ACX	276/300
VK6RU	301/324	VK3ARX	270/278
VK6MK	300/317	VK3TL	268/272
VK4FJ	293/315	VK3NC	267/267
VK2VN	285/300	VK2JA	265/283

A.O.C.P. THEORY CLASS

The Victorian Division of the W.I.A. will commence a **theory class** in February 1967.

Those wishing to enrol should do so immediately by contacting the Administrative Secretary, P.O. Box 36, East Melbourne, or by phoning 41-3535.

HAMADS

Minimum 50c, for thirty words. Extra words, 2c each.

Advertisements under this heading will be accepted only from Amateurs and S.w.l's. The Publishers reserve the right to reject any advertising which, in their opinion, is of a commercial nature. Copy must be received at **P.O. Box 36, East Melbourne, C.2, Vic., by 5th of the month and remittance must accompany** the advertisement.

SELL: Army Power Supply, 2000 v. at 300 mA., perfect. Also BC221 Frequency Meter with own book. Also commercial amplifier with EL34, suitable public address, etc. Take best offer. Phone 84-7316 (Melbourne).

FOR SALE: A.W.A. Communication Rx, with circuit, plug-in coils, 5 to 22 Mc., signal meter, crystal filter, b.f.o., etc. $50.00. Phone 99-1456 (Melbourne).

FOR SALE: Heath VF1-U V.F.O., all bands to 28 Mc., perfect order, includes book, $25. S. Dogger, VK2ZRD, 30 Finlay Av., Earlwood, N.S.W.

FOR SALE: Petrol Generator, 2 h.p., 4 stroke, air-cooled motor, 3-brush generator, 12-28v., regulated approx. 50 a., $66, O.N.O. 2 mtr. 100w. table top Tx with 75w. mod., xtal and v.f.o. controlled, complete with rack mounting h.t. supplies, $160, O.N.O. Three 2-mtr. 10-element Yagis on 12 ft. booms, $10 each. Low Noise (W2AZL) 417A 2-mtr. Xtal Conv., with pwr. supply, $40, O.N.O. BC455 Rx (6-9 Mc. Command), $14. Battery operated transistor Tape Recorder, $16. Modified 522 2-mtr. TX, 30w., EL34s, in modulator, $10. Field strength Meter for 2 metres, batt. operated, $6. A.W.A. T.V. Tuner, 13 ch., $14. Acos HGP40 Pick-up with heads, $6. 2-mtr. Turnstile mobile Ant., $6. 2-mtr. Final in copper box, ¼ wave tuned lines in grid and plate ccts., suitable for 6/40s or 829Bs, $20. 7 Mc. xtal Conv. (transistorised), B/C band I.F., $16. 50w. Mod. Txfr., prim. Z 0-7.5k, sec. 5k and 8k c/tapped, $12. VK3JS, R. C. Whitaker, Flat 5, 9 Thames Prom., Chelsea, Vic.

SELL: Drake 2B Rcvr., with Q multiplier and handbook, perfect condition, $360 or offers. A.M. Rig, table cabinet, aluminium, 22 x 12 x 12, 140 watts, no junk parts, Geloso v.f.o., etc., pair 809 mod., pair 6146 final, $90 or offers to VK5WG, C. E. Schmidt, 5 Chitunga Rd., Eden Hills, South Aust.

SELL: 3BZ, Tx, $20. 2 only BC659 F.M. Car Phones, $16 each. AT5 Tx, $9. AT5 Coupling Unit, $5. Canadian Tx, two 807s, 12v. genemotor, $8. Bendix TA12, original condition, modulator and channel selector, $30. Mini for wire recorder, $30. Philips Eliminator $4. R. & H. Transmitters, 6v6, 807, 807, $10. Early 522 Tx Rx, $11. VK3AQB, 20 Ovens St., Yarraville, Vic. 68-6557.

WANTED: Collins KWM2 or 32S-3. Send details, lowest cash price, or see my ad. December "A.R." Tom Dineen, VK3TD, Stephens Rd., Mt. Eliza, Vic. Phone Melb. 787-1407.

100 Kc. Xtals, type AR2W, new, $5.50. VK4SS, 35 Whynot St., West End, Brisbane, Qld. Phone 4-8526.

A LARGE RANGE OF TRANSMITTERS, RECEIVERS, TEST GEAR, AND DISPOSALS RADIO PARTS AVAILABLE

★ **ARR2 V.H.F. RECEIVERS**
234-258 Mc. Tube line-up: three 6AK5s r.f., 9001 1st mixer, 9001 oscillator, 9001 2nd mixer, 9001 i.f. amp., 9001 detector, 9001 b.f.o., 9001 b.f.o. control, 12A6 audio output. 1st i.f. 540-1030 Kc. 2nd i.f. 200 Kc. $5.00 complete with tubes. Circuit 50c.

★ **T.V. POWER TRANSFORMERS**
Voltage Doubler. Primary 200-220-240v., Secondary 218v. 270 mA., 6.3v. 8a. $1.95.

★ **T.V. I.F. STRIPS**
Completely wired three-stage 36 Mc. i.f. strip. Video and sound take-offs. Australian manufacture, well known make. Tubes used, three 6BX6s. Price less tubes, $1.50.

★ **TRANSCEIVERS, TR1986-7**
115-145 Mc. Employs heterodyne exciter in tx. TT15 p.a. Single xtal locks Tx and Rx on same frequency. In-built modulator. Supplied with 4.86 Mc. xtal. $30, circuit $1.

THIS STORE WILL CLOSE ON 24th DECEMBER AND RE-OPEN ON 16th JANUARY, 1967

★ **SR550 DUAL CONVERSION COM. RECEIVER**
160 metres to 6 metres, Amateur Bands only. 3.5 Mc. xtal band edge marker, xtal supplied, product detector for s.s.b. $240, 10% discount for cash.

★ **SCR522 V.H.F. TRANSMITTER/RECEIVER**
100-150 Mc. Complete with tubes, $28.

★ **PERSPEX SHEET**
1/16 inch thick. Size 4¾" x 16". $1 per sheet.

★ **COMMAND TRANSMITTERS**
4-5.3 Mc., 5.3-7 Mc. Complete with tubes, $15.

★ **TR3624 TRANSMITTER/RECEIVER**
Approximate frequency, 200 Mc. Contains 46 miniature tubes, $30.

WANTED TO BUY

Communication Receivers, Test Equipment, etc. Call, write or phone. Equipment inspected and picked up at your convenience any night or week-end.

★ **VALVES**
EF50, 20c ea.; 7C7, 10c ea.; CV131, 6CQ6, 50c ea.; 6AC7, 20c ea.; 6AL5, 20c ea.; 6C4, 6AM5, 50c ea.; 6J6, 50c ea.; 6FQ5, 50c ea.; 12AD6, 60c ea.; 12AU6 60c ea.; 12BA6, 50c ea. Mullard MW6-2 t.v. projection tube, 3", $1.50.

★ **SIGNAL GENERATORS**
TE22 Audio Generator, freq. range: sine 20 c.p.s. to 200 kc., square 20 c.p.s. to 25 kc., in four ranges. Output, 7v. p-peak. Output impedance, 1,000 ohms. Price $42.

★ **METERS, P25 TYPE**
0-500 uA., $5.25; 0-100 uA., $6.95; 0-1 mA., $4.50; 0-10 mA., $4.50; 0-50 mA., $4.50. Full range of Meters and Multi-Testers available.

★ **CURLY CORDS**
4-conductor cable, unextended length 4 ft., extend to 18 feet. $1.25.

★ **COMPUTER BOARDS**
Contains five OA202 silicon diodes. Pot core, capacitors, etc. 75c each.

★ **SWITCH POTS**
Miniature transistor radio type pots. 2 megohms and 5 megohms. 12c each or 10 for $1.00.

★ **DYNAMIC MICROPHONES**
DX29 high impedance, with in-built gain control and desk stand. Response 100-15,000 c/s. $7.50.

★ **MILLER 455 Kc. PRE-WIRED I.F. STRIPS**
Comprises two i.f. stages, ceramic filter, diode detector, 55 db. gain, NPN silicon transistors, d.c. requirements 6v. d.c. 2 mA., size 1½ x ½ x ½ inch. $8.70 inc. tax.

★ **TR10A MULTIMETERS**
100,000 ohms per volt. Ranges, d.c. volts: 0.5, 2.5, 10, 50, 250, 500, 1K.; a.c. volts: 2.5, 10, 50, 250, 1K; d.c. current: 10 uA., 1 mA., 25 mA., 250 mA., 10 amp.; resistance: 20K, 200K ohms, 2 megohms, 20 megohms. To clear, $25.95.

★ **POTENTIOMETERS**
Wire wound, 40c each; carbon, 25c each.

★ **RESISTORS**
¼ watt, I.R.C., Welwyn, Eire, Ducon, Philips, $2 per 100.

★ **¾ H.P. 2-STROKE MOTORS**
Ohlsson and Rice. Brand new, just imported from America. Weighs only 5¾ lbs. 6,300 r.p.m., supplied with 3 : 1 reduction gearbox, output 2,100 r.p.m. Ideal for driving Alternators for Field Days. Fuel consumption 1 pint per hour. $30.

ANY QUERIES

Beginners are welcome, ask Jim and Laurie Gardiner any questions. They are Amateur Radio operators and will be only too pleased to assist.

★ **CRYSTALS**
Personal shoppers only, $1 each.

★ **SPECIALS**
New 815 valve, $1. New DA41 (TZ40), $1.50.
3000 type Relays, 50c each.
Inter-Office Phones, 15-station type, $4 each.
7-pin skirted Valve Sockets, P.T.F.E. insulation, silver plated, only 20c each, c/w. shield.
Speaker Transformers: 7000 ohms to 2 ohms; 10,000 ohms to 3.5 ohms; 50c each.
9-pin skirted P.T.F.E. Valve Sockets with shield, 50c each.
3 uF. 1000v. d.c. Block Capacitors. Only 25c each or $2 per dozen.

★ **MINIATURE CAPACITORS**
New shipment. 600 v.w. Values: 0.001, 0.02, 0.005, 0.0005, 0.0002, 0.0001 uF. $2 for 80, plus freight.

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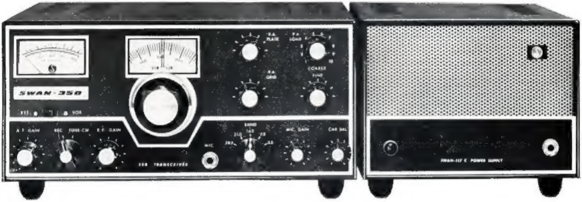
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